Science & Mechanics

Complete HANDYMAN ENCYCLOPEDIA

18

SWIMMING POOL TOOLS

Do-it-Yourself

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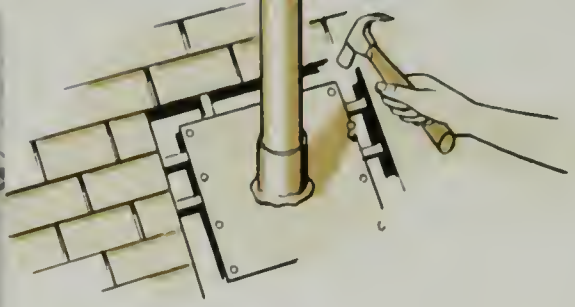

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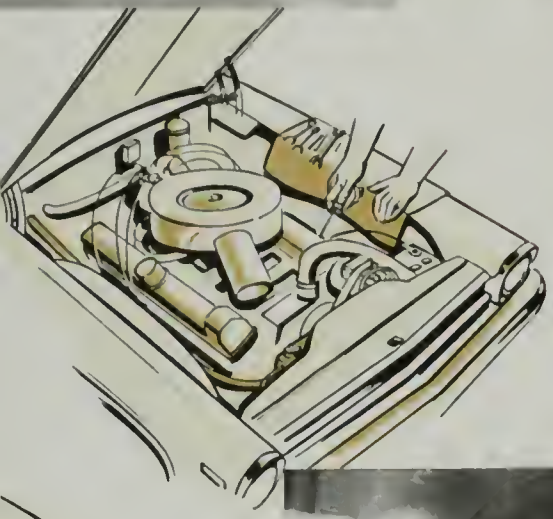

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Complete Handyman yourself Encyclopedia

A COMPILATION OF NEW AND PREVIOUSLY PUBLISHED SPECIAL INTEREST PROJECTS AND MANUALS FOR THE REPAIR AND CARE OF HOMES, AUTO, APPLIANCES, HOBBY EQUIPMENT.

by the editors of

Science & Mechanics

18

SWIMMING POOL TOOLS

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VOLUME 18

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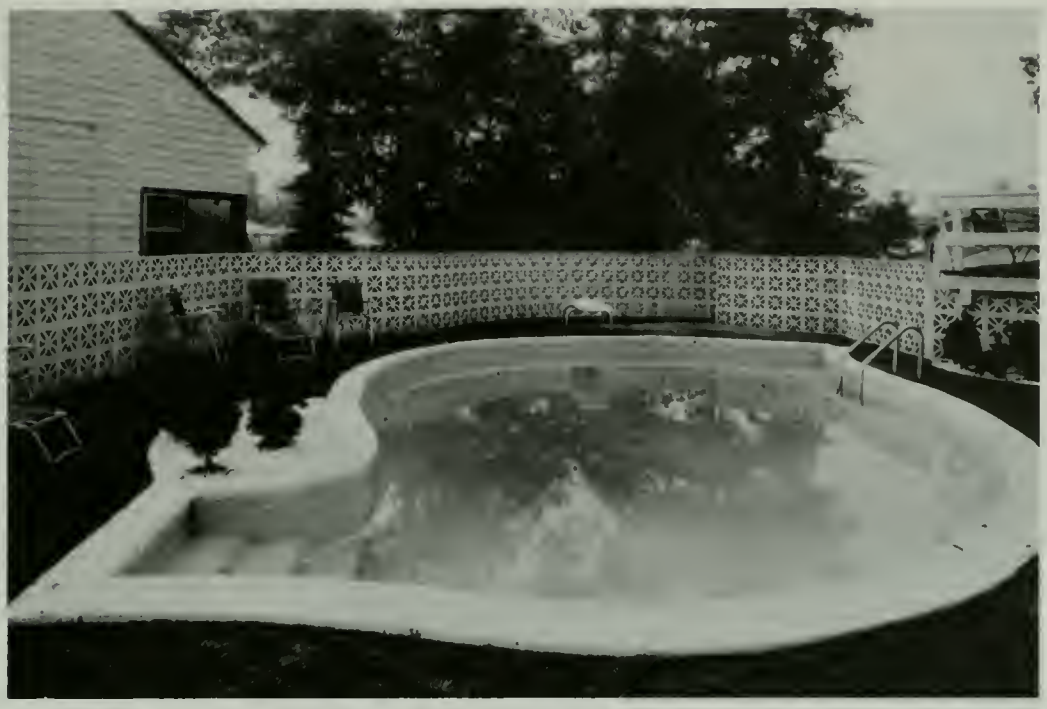


How to Select Your Swimming Pool

A backyard pool can be a major investment. Choose carefully to avoid headaches and excess costs

IF YOU DECIDE TO INSTALL a swimming pool in your yard, you are making a major improvement in your property. Proceed carefully to prevent your enjoyment of a pool from being outweighed by the headaches, and the costs from exceeding the value of the improvement.

Careful planning and selection of a contractor takes effort, but it's worth it.

Talk over your plans with as many contractors as you can find to get a feel for what can be done, how much it will cost and the price range between the lowest and the most expensive offer. Never make a decision after talking to only one or two salesmen. Also, talk to as many people as you can find who own pools already. Find out who built them, what kind of work they did and if they were prompt in correcting deficiencies.

The best location for a pool is near the house. This provides convenience and makes it easier to keep the pool under observation, especially when youngsters are using it.

In addition, a site near the house will usually put the pool within easy reach of electric and water service.

Consider how the pool and fence that you will probably have to build around it will blend with the overall layout and landscaping of your yard. Choose a sunny spot for the warmth of bathers and one sheltered from the wind, either by a natural wind-

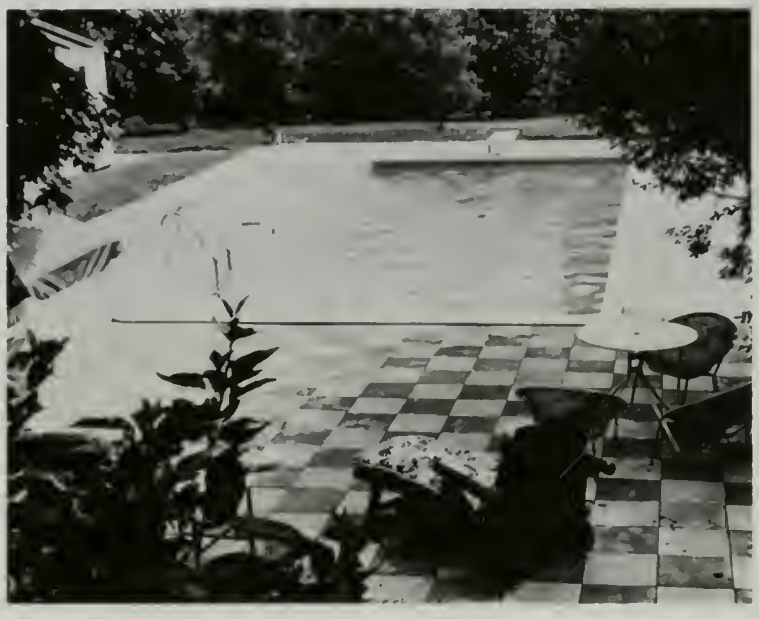
swing, lawn: see furniture, outdoor
switch, headlight: see automobile
switch, remote control: see remote control switches
switch, wall: see wall switches

break, such as a hedge, or even a canvas backdrop. This will make your swimming season several weeks longer—even more if you have a water heater.

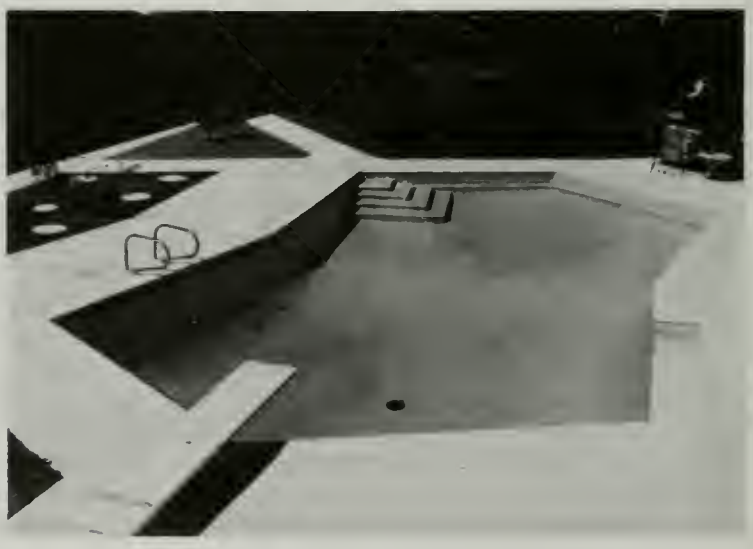
Avoid a location under large trees. The shade will make the pool area cooler and falling leaves and seeds will add to the work of keeping the pool clean.

A wide variety of swimming pool shapes and sizes is available. Many are stock designs, or even prefabricated. Or, you can have a shape custom-made to your specifications, although this is more expensive. In this case you will need to rely on the contractor's advice on meeting safety standards.

In any case, talk to suppliers about the shape and type in terms of what is suitable



Rectangular swimming pool is one of the most common designs and one of the simplest to build.



A swimming pool like this one can increase the value of your property appreciably, but it may also increase your tax assessment. Check local regulations carefully when you decide on installation of a pool.

A prefabricated glass-fiber pool being lowered into its excavation. The steep drop-off visible between the shallow and deeper sections illustrates a problem typical in small pools—it's impossible to achieve a gradual change in depth in a short distance. A safety line with floats rigged across the end of the shallow section is a must, and small children should never be allowed near the pool without a responsible adult there.

for the terrain and climate where you live, the costs, and the way you and your family and guests will use the pool.

Terrain can be particularly important when rock or ground water will create excavation problems.

Generally, a 12 x 27-foot pool is considered the minimum practical size, although many families enjoy smaller pools. A 20 x 40-foot pool is a widely used size and provides plenty of room for swimming and diving.

Swimming pool companies usually include the basic equipment as part of the pool package. This ordinarily will include a filter and pump, diving board, underwater light, leaf skimmer, vacuum cleaner, ladder and lifeline anchor.

The contractor you finally select to build the pool may offer to arrange financing. However, you may get a better deal at a bank. In addition, if you borrow from a bank, you can ask at the bank about the reputation of the contractor.

One word of warning. If you finance through the contractor, it doesn't mean that you can avoid paying back the loan if the contractor defaults. Usually, contractors sell finance agreements to third parties. If the contractor fails to complete the work satisfactorily, the third party is still legally entitled to payment.

Whatever financing arrangement you choose, make certain that everything is spelled out clearly in writing. Do not accept spoken assurances for anything either in finance agreements or in the contract to build the pool.

Items that should be included are the exact total cost of the pool and a complete description of the work to be done, including the specifications of materials—grade, name, weight or size, color, style and cost, etc. If relocation of water or electrical lines is required, this should be included in the contract. Every expense, such as labor, materials, optional equipment, etc., should be spelled out.

See also: HOME OWNERSHIP; PLUMBING; SAFETY, WATER; SWIMMING.

WHERE TO FIND IT

One helpful source of information is the National Swimming Pool Institute, 2000 K Street N.W. Washington, D.C. 20006. This is an industry association, which offers several publications on swimming pool selection and maintenance, some free and some at a small cost.

The Care and Maintenance of Your Swimming Pool

Keeping your pool safe for your family and guests means keeping it free of dirt, algae and bacteria

YOU CAN BE SURE that your swimming pool is a healthful, attractive place for family recreation, if you keep it free of dirt, algae and disease-causing bacteria.

The single most important component of your pool is the water. It's what you swim in. It's what the pool is designed to contain and what the filter system is designed to keep clean.

Ordinarily, water is taken for granted in most of the United States. Turn on the tap and it's there. When you shower, do the laundry or wash dishes, you use water and throw it away without even a thought.

This is not the case with a swimming pool. Once you fill the pool that filling will last several seasons, although some water will have to be replenished to make up for evaporation, splashing, etc.

Think of the water in your pool as part of the equipment. Like your car, it requires maintenance. If you don't take care of it, the water will deteriorate and become unstable.

Fortunately, the water in your pool is easier and cheaper to maintain than an automobile.

The simplest maintenance is keeping the pool free of dirt and debris such as leaves, hair, lint, etc. This done by scooping out floating leaves and the like, scrubbing down the walls and deck, vacuuming the bottom and cleaning the filter system.

Keeping the pool free of algae and bacteria is done chemically. This requires care, although you don't need to be a chemist to do it. The required materials and test kits are widely available from swimming pool supply dealers with complete, easy-to-follow instructions.

Establishing a healthful chemical balance in your pool requires the consideration of three factors—the amount of free residual disinfectant, pH balance and total alkalinity.

Free residual disinfectant is the amount of disinfectant, such as chlorine, that is present in the water and is actually available to kill bacteria. This is expressed in parts per million, often abbreviated to ppm. If, for example, the free residual chlorine in your pool is 1 ppm, it means that there is one drop of chlorine available to kill bacteria for each million drops of water.

The pH balance is the measure of alkalinity or acidity of the water. The pH balance in a swimming pool is expressed on a scale from 0 (very acid) to 14 (very alkaline) with 7 as neutral. Swimming pool water should be slightly alkaline—between 7.2 and 7.6. If the pH balance is lower than 7.2 the water will irritate swimmers' eyes. If it is higher than 7.6, the disinfectant will begin to lose effectiveness.

Total alkalinity is the total amount of alkaline chemicals dissolved in the water. This, like free residual disinfectant, is expressed in ppm. This is important because if total alkalinity is too low (below 80 ppm), the pH balance of the water becomes subject to rapid fluctuations.

The most widely used swimming pool disinfectant is chlorine. It is available in several forms. Elemental chlorine gas is used to purify public water supplies and for large commercial and club pools, but it is dangerous to handle without special equipment and is used in home pools infrequently.

Chlorine for home pool use comes in liquid and dry chemical compounds. Enough is added to the water to mtaintain a level of free residual chlorine between 0.6 and 1 ppm.

Other common disinfectants are bromine and compounds of iodine. These have different requirements for free residual disinfectant, so read the maker's instructions carefully.

Liquid chlorine is somewhat unstable, so do not buy it too far ahead. Often, an alkali is added to retard spoilage. If this is the case, adding chlorine will also increase the pH balance. Check this after you have added chlorine and adjust the balance with a neutralizer, if necessary.

Dry chlorine is available in granular and tablet form. Some of these compounds, too, are mixed with an alkali and may require pH adjustment.

Disinfectant chemicals are easy to apply. Some pools have automatic feeders that need to be adjusted from time to time to match the demand for chemicals.

If you are adding chemicals by hand, be careful not to let them splash on your skin or clothes. Liquid disinfectants are simply poured into the water. Start at the deep end

and walk all the way around the pool as you pour. Dry chemicals should be distributed evenly. Some are sown into the water like lawn seed. Others are hung in bags or other containers in the water near the deeper end.

The length of time between disinfectant treatments varies. Bathers and wind-borne dirt add bacteria to the pool, so a windy day or a heavy bathing load will speed the consumption of disinfectant.

Heat and light decrease the life of the disinfectant. It is expended faster on sunny days and when the water is warm than it is on shady days or when the water is cooler.

The pH balance also affects disinfectant. A high pH retards the action of the disinfectant, so more is required.

The three key factors, free residual disinfectant, pH and total alkalinity are easy to measure with inexpensive test kits available from dealers in swimming pool supplies.

POOL CARE TIPS

The Pool

Pools are for swimming in . . . learning in . . . relaxing in . . . playing in, but not horseplaying or roughhousing in! Invest in a couple of good safe pool games such as water basketball, floating checkers, and water volleyball.

Establish sensible pool rules at the very beginning; enforce them constantly.

Learn to swim. Make sure all pool users are well qualified. Pools are for swimmers . . . non-swimmers have only one reason to be inside a pool and that's with a qualified teacher learning to swim.

Be careful of inflatable toys and mattresses. Remember: Those items are also deflatable.

Provide responsible adult supervision at poolside at all times.

Pools are like driving an automobile: They don't mix well with alcohol.

Never swim alone or allow others to do so. Sudden cramps can occur even in the most accomplished swimmers.

Be careful when diving from the deck of the pool. That's what diving boards are for.

Stay out of the water during rain storms—a particularly important rule if there's also lightning.

Health

Many pool companies offer weekly, monthly, and bi-annual pool service. These companies will prepare your pool for safe, healthy swimming in the spring; keep it in top shape during the season; and close it for the winter. At a minimum, periodic inspections by professionals are encouraged.

Clean and vacuum the pool regularly to clear the debris and dirt from the pool. (Many pool companies are now offering various types of automatic equipment which make this job easier and faster.)

The pH level of the pool is important in providing a safe and healthy environment in which to swim. Keep an inexpensive pool testing kit handy and use it often. Provide chemical treatment as indicated.

Water which has been chemically treated for several years gradually begins to lose its ability to respond properly to further treatment. When this happens, it's time to drain the pool, make necessary repairs, and fill with fresh water.

Make pool upkeep the responsibility of the entire family.

Hair lotion and suntan oils make a nice appearance at poolside, but are hard on your pool's filtration system. Shower before entering the pool.

Swimmers with open sores and infections should not use the pool.

Use a pool cover to keep your pool clean during long periods when not in use.

All portable wading pools should be emptied at least daily, more often if many children use them in one short period.

Diving Boards

Diving boards should not be installed on residential swimming pools which were not built to accommodate them. Check with your pool builder on this.

Children, particularly, like to adjust the diving board to get the most "bounce for the ounce." Make sure your board cannot be adjusted to provide too much spring for the amount of water available to catch the diver safely before he hits bottom.

Pay close attention to the surface of the board, making sure the anti-slip surface is always in good repair.

Allow jumps and dives only from the front of the board.

Residential pool diving boards were not designed for use in Olympic tryouts. Keep the dives simple.

Make sure other people don't play around or under the board when it's in use. A lifeline across the pool where the deep-end slope begins will help separate the two parts of the pool, and also keep inexperienced swimmers out of deep water.

Jump boards and water slides require the same attention and care as do diving boards.

Outside the Pool

A fence should be erected (in many locales, it is required) to completely enclose the pool to guard against unwanted intrusion by "shortcutters," children, and animals. NSPI recommends a minimum four-foot-high fence with safety locks, which are inexpensive and readily available. For above-ground pools, make sure the ladder is stored safely off the ground when pool is not in use.

Pool alarms are inexpensive and effective.

Pool covers add extra protection and help keep the pool clean, especially during long periods such as vacations and winter time when pool is not in use.

Many pools are equipped with underwater lights; turn them on at night. In any case, a single outdoor spotlight, at a minimum, which turns on automatically at dusk is a wise investment.

Provide a ring buoy with lifeline attached at poolside for emergencies. Also keep the long handle of the pool skimmer out in plain view. It can be extended to a tired swimmer. A handy first aid kit is a practical addition, too.

Keep the deck around the pool clear of debris and clean of any slippery substances.

Paper and plastic cups and dishes are practical at poolside

Never allow any electrical appliance such as a portable radio anywhere near the pool water or pool users.

Check the pool equipment carefully and frequently, especially if it is electrically operated. Get professional help at least annually for the more sophisticated equipment like heaters, pumps, and filters.

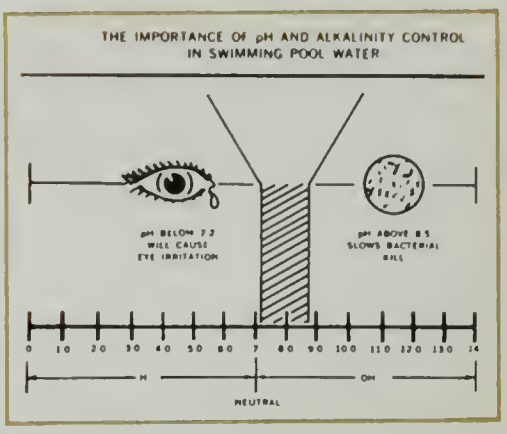
The sun is a non-pool hazard, but can be dangerous in big overdoses.

NOTE: These tips for the safe operation of residential swimming pools were compiled by the National Swimming Pool Institute.

To test for free residual disinfectant, purchase the kit appropriate for the type of disinfectant you are using. Take a small sample of pool water as directed, add a measured amount of a color-reacting chemical and compare the color of the liquid in the test tube with a color chart supplied with the kit.

The color indicates the amount of disinfectant from pale (very little) to intense (a lot). If the color matches the standard sample, your pool water is acceptable. If the sample is too pale, add disinfectant until the test indicates there is a sufficient amount present.

A similar color test will indicate the pH balance of your water. Be careful when making this test not to let your fingers touch the sample or the portions of the test equipment exposed to the sample. Acid



Pulling the strainer basket from the pool filter for cleaning.

Leaves and other debris that accumulate in filter basket must be removed periodically.

from your skin could give a false test reading. Make this test after adding a chlorine or other disinfectant to your water.

If the test results show that pH is too high or too low, add the appropriate chemical to restore the correct balance. Soda ash is the usual chemical used to raise pH. It's cheap and easy to apply. Simply walk around the pool sowing it in the water the way you would sow grass seed.

Muriatic acid is frequently used to lower pH. It is about 30 percent hydrochloric acid and is available from pool supply dealers, as is an acid demand kit that will indicate how much acid is needed.

Never add more than a pint of muriatic acid in a single dose. Pour it into the pool and wait overnight. Test the pH the next day. If it is still too high, add another pint of acid and wait another day before testing again. Repeat the process until the pH is between 7.2 and 7.6.

Remember muriatic acid is an acid. Don't let it spill on your skin or clothes. If it does, wash it off immediately.

Sodium bisulfate is an acid available in dry form. It will do the same job as muriatic acid.

Occasionally, test your pool for total alkalinity with a kit available from dealers. Low alkalinity makes the water less resistant to changes in pH. A suitable alkalinity level is between 80 to 100 ppm of alkaline salts to water. If the level is too low, add baking soda. As a rule, 1½ pounds of baking soda will add 10 ppm to 10,000 gallons of water.

Although chlorine can prevent the growth of some algae, it does not kill all algae, particularly the "black algae" that causes the most difficulty in swimming pools.

Algae can clog filters, make pool surfaces dangerously slippery and make the pool seem dirty. In addition, they can decrease the effectiveness of the chlorine or other disinfectant used to kill bacteria.

A variety of algicides are available from swimming pool supply dealers. Make sure the one you choose is effective against all varieties, especially black algae, that it will not interfere with your disinfectant and that it is not harmful to swimmers. Once you have chosen an algicide and found it effective, use it regularly.

Chemicals can't do the entire job of maintaining your swimming pool. It also requires regular cleaning.

Use a standard hand skimmer—basically a net on the end of a long pole—to skim leaves and other floating debris from the surface. Scrub down the walls and tile with a stiff bristle brush.

Clean the automatic skimmer and the pump's hair filter. This is simple, just remove them, pick out the debris and throw it away and put back the skimmer and filter. This should be done at least daily, more frequently with heavy pool use and in the early spring and fall when there is heavy fallout from trees and bushes.

Vacuum the pool bottom. Vacuum cleaners are usually supplied with the pool. Some get their suction from a special fitting in the pool side, others from a fitting at the pool pump.

When the pool's basic filter has collected an overload of dirt, pressure will rise within it and the flow within the system will drop. When this occurs, the filter must be backwashed and cleaned, according to the manufacturer's instructions.

The final step in pool cleaning is to wash down the deck with a garden hose.

See also: SAFETY, WATER; SWIMMING.

WHERE TO FIND IT

The National Swimming Pool Institute, 2000 K Street, N.W., Washington, D.C. 20006, is an industry trade association. It has several booklets and pamphlets on residential swimming pools available at low cost. Write to them for information.

Drop Leaf Coffee Table

This handsome coffee table is relatively easy and inexpensive to build, and it fits in with almost any decor

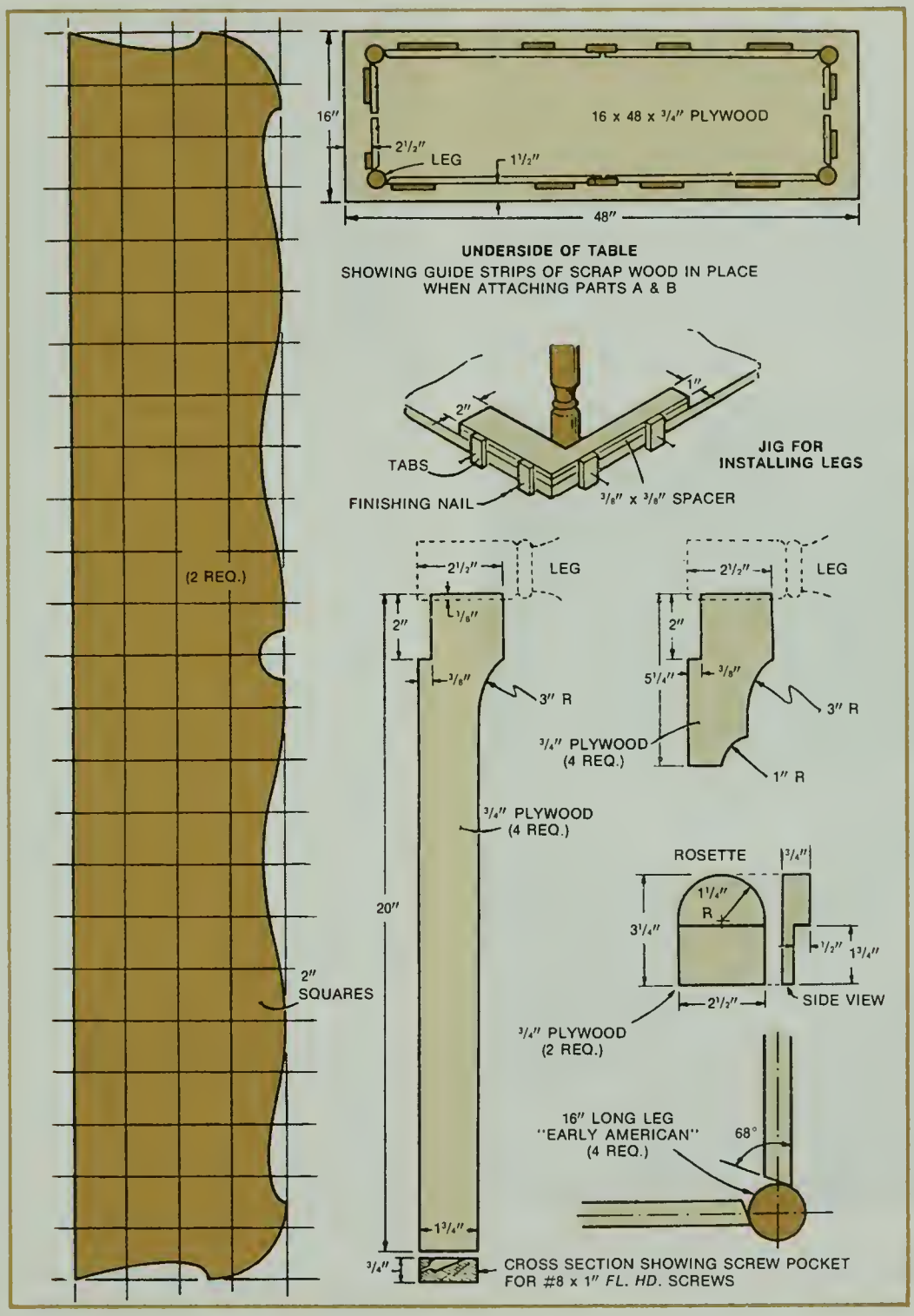
THIS DROP LEAF COFFEE TABLE is 48 inches long and 16 inches wide when the leaves are down. When the leaves are raised, the table doubles in width to a handy 32 inches and it fits in with most types of interior decor.

The table shown here was built with birch, one of the fine hardwoods, but you can select one of the many other woods, such as mahogany, cherry, walnut, or maple, to suit your decorative preference. The do-it-yourself legs are sold by many hardware and lumber dealers. The plywood edges are covered neatly with a flexible wood trim, also available from local lumber dealers. The overall cost is slight when you do your own building.

First step in construction of the table is to cut and shape the four end rails, each 5¼ inches long, and the four center rails, each 20 inches long, to frame out the leg section. These are cut from 2½-inch wide strips of ¾-inch plywood. Make a cardboard pattern for each of the parts, according to the drawing. Trace the outline of each pattern for two parts, then flip the pattern over to get the contours of the adjacent two parts.

Note that one end of each part is cut for a 68° angle, to butt against the round legs.

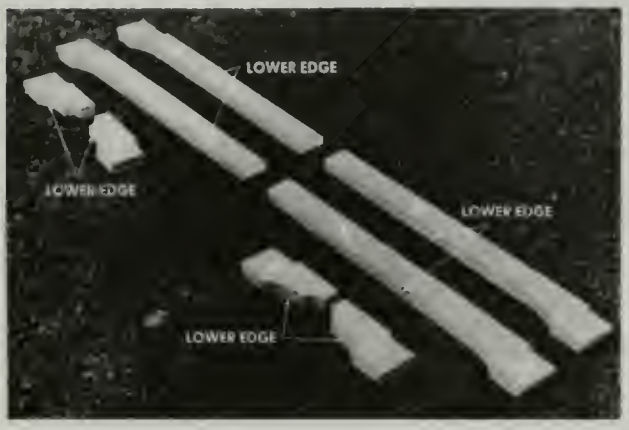
table, coffee, see furniture, indoor
table, parsons: see parsons table
table, patio: see furniture, outdoor
table, picnic: see picnic table
table, pool: see pool table


16"
16 x 48 x ¾" PLYWOOD
2½"
LEG
1½"
48"
UNDERSIDE OF TABLE
SHOWING GUIDE STRIPS OF SCRAP WOOD IN PLACE
WHEN ATTACHING PARTS A & B
2"
1"
TABS
FINISHING NAIL
⅜" x ⅜" SPACER
JIG FOR
INSTALLING LEGS
(2 REQ.)
2½"
LEG
2"
⅛"
⅜"
3" R
¾" PLYWOOD
(4 REQ.)
5¼"
1" R
20"
2"
SQUARES
ROSETTE
¾"
1¼"
R
3¼"
½"
1¾"
SIDE VIEW
¾" PLYWOOD
(2 REQ.)
16" LONG LEG
"EARLY AMERICAN"
(4 REQ.)
68°
1¾"
¾"
CROSS SECTION SHOWING SCREW POCKET
FOR #8 x 1" FL. HD. SCREWS

Each part is notched ⅜-inch deep to allow clearance for the metal leg plates. Trim the lower edge of each piece with the flexible veneer strips.

Next, make the two drop leaves, shaped from pieces of ¾-inch plywood 8 inches wide and 48 inches long. Keep the best side of the wood on the outside for each piece, which means that you must reverse the pattern when tracing it on each of the two sections. Trim all four edges of each table leaf with the flexible wood veneer.

Cut the rectangular table top to size (16 x 48-inch) from ¾-inch plywood, selecting the best side of the stock for the top surface. Do not edge-trim the table top until later, when the legs have been attached.



After the rails have been cut to size and shape, cover lower edges with flexible wood trim. Note 68° angles at ends.

This is how the plywood drop leaves look when cut to required contour and edges have been trimmed with a veneer strip. Use best side of plywood for leaf surface.

A simple jig is made to simplify positioning of the legs. Rip scrap pieces of ¾-inch plywood to ⅝-, 1-, 1⅝-, and 2-inch widths.

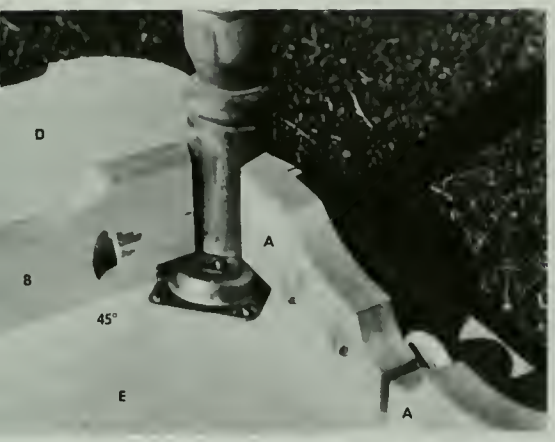
Combine a 1⅝- and 2-inch strip along the underside of the table top, the narrow strip underneath and flush with the edge of the top. Thus there is a ⅜-inch clearance at the bottom for the metal leg plates. Do the same with the other two pieces along the side of the top. Support these strips with wood scraps nailed onto the plywood edges to form a right angle corner.

Screw the leg plate onto the leg stud, and hold the leg upright into the corner, tight against the jig parts as shown in the drawing, with the leg brackets positioned at 45° to the side strips. Mark or center-punch the accessible holes in the metal plates and drive in the bracket screws. When the jig is removed, you can put in the rest of the bracket screws. Repeat this process at each of the corners, then trim the table top edges with veneer.

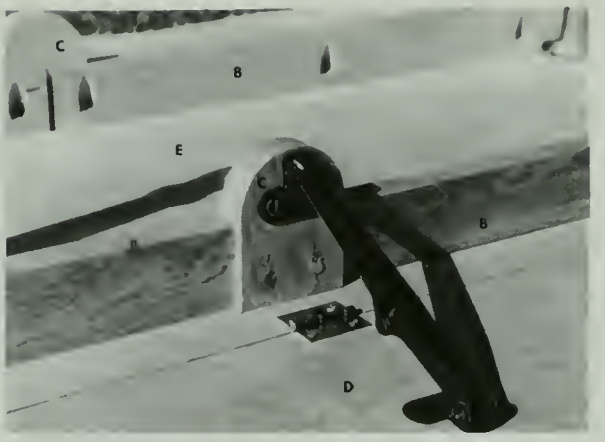
To attach the rails between the legs, draw guide lines 2½ inches in from the ends and 1½ inches in from the sides of the table top. Nail guide strips temporarily along the lines, making sure the nails do not go all the way through the top.

Drill slanted screw pockets into the inside surfaces of the rails and attach these parts with glue and screws while holding them tightly in position against the guide strips, with the angled ends against the round legs. Use #8/1-inch wood screws, driven in tightly. Make two rosettes to fit on each side at the center rails.

Attach the drop leaves with brass butt hinges, three on each side, and the drop leaf supports, which are connected to the brace. When you put on the hinges, center-punch each screw hole carefully so that the screws



Early American turned leg is in straight-up, rather than sloped, position on its metal support-bracket, which is placed at 45° diagonal to the sides.



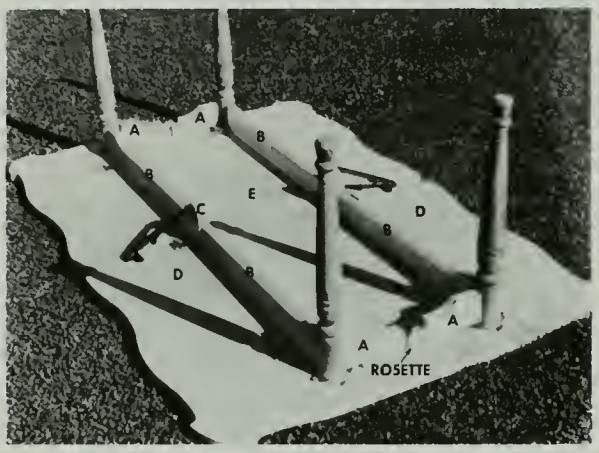
Parts are firmly attached at center of the long sides to support drop leaves when in open position. Leal hinge goes in center. Leaf is lowered by releasing support-bracket.

will not shift the hinges when driven in all the way. In this way, the three hinges will stay in alignment and the table leaves will be more neatly fitted and butt uniformly against the table top when raised. At the center gap of the two rails on each end, place a rosette or other decorative cover if you wish, or the space may be left intact.

The legs come sanded smooth, ready for staining. The table top, edges and drop leaves should be given a light sanding with fine paper, then two coats of finish, sanded lightly with extra fine sandpaper between coats.

Original design by Steve Ellingson.

See also: FINISHING, WOOD; FURNITURE, INDOOR; PARSONS TABLE; SERVERS; TRAYS; WOODWORKING.

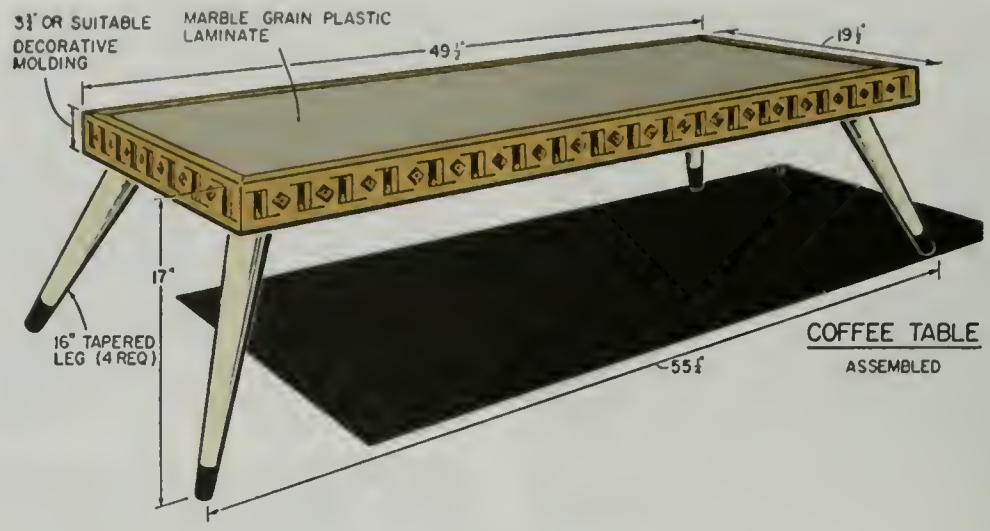


Underside of completed table. Note rails neatly butted against leg posts. The rails strengthen top and also help support drop leaves. Decorative rosettes are optional.

MATERIALS LIST

Quantity	Size and Description		Purpose
1	3/4"	4'x4' birch plywood	basic unit
6 rolls		flexible wood trim to match plywood	
4	16"	Early American legs with brackets	
2	6"	drop leaf table supports	
as needed	1"	#8 flat head wood screws	

NOTE: Also need butt hinges, contact cement, decorative rosettes and finishing materials.



How to Assemble an Elegant Coffee Table

Most of the parts of this stylish addition to your living room are stock items, which makes it easy to build. You probably can do it in an evening

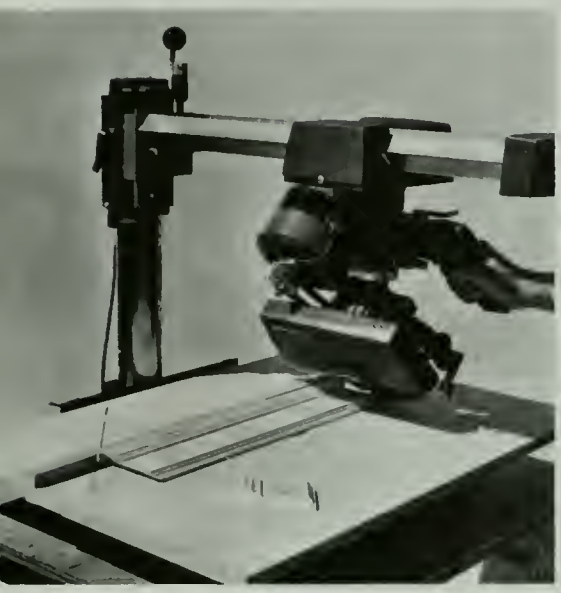
THIS ATTRACTIVE COFFEE TABLE features a stain-resistant plastic laminated top, such as Formica, enhanced with embossed molding. The tapered legs with brass ferrules are stock items which can be purchased at any lumber yard. They come in various sizes and may be mounted straight or at an angle.

The laminated material selected for the table top was a white and gold marbleized pattern. The legs were finished in white paint, and the molding in white and gold antique to match the top. Construction is quite simple and except for a few saw cuts and drilled holes, it is mostly a matter of assembly.

Make the top first by laminating the plastic to a piece of ½-inch fir plywood. Both the wood and laminate should be slightly oversize to allow for any discrepancy in laminating. Coat both the surfaces to be joined with contact cement following the manufacturer's recommendations.

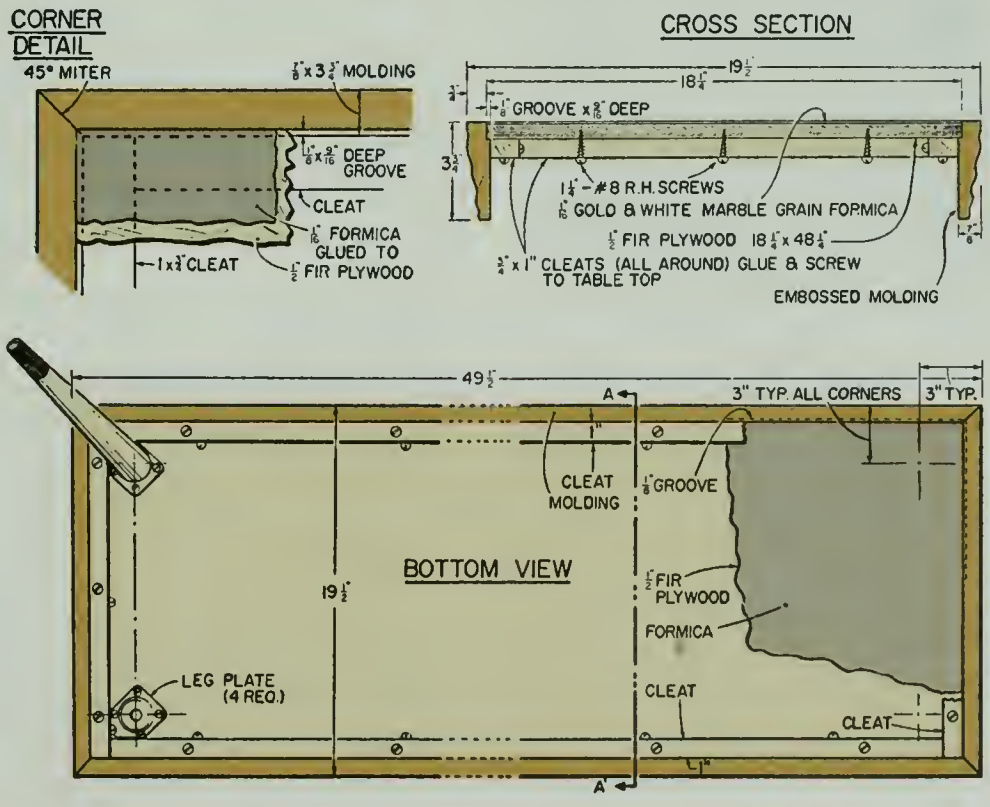
While waiting for the cement to air dry, cut the necessary cleats to size and drill the screw pilot holes both vertically and horizontally. Be sure to drill the holes square. The top should now be ready to laminate. Carefully locate the pieces, and then press down firmly, working from the center out. Follow this with a hammer and block pounding every square inch of the top to assure a perfect bond.

Next, trim the top to size and cut the molding to fit. Set your saw at 45° and make a few test cuts on scrap to be sure of a perfect miter.



▲ *Bevel cuts for molding are made by tilting saw to a 45° angle.*

▲ *Formica is laminated to plywood top with contact cement.*



Cleats are drilled and screwed beneath top.

Tapered legs are affixed.

Corner brackets are attached as close to corners as possible with small screws.

With all the pieces cut, you are now ready to assemble. Coat all mating surfaces with white glue, then assemble with round head screws. Wipe any glue that may ooze out of the joint with a damp cloth. The leg plates are mounted last with the pointed end facing the corner.

The legs and molding are given a wash coat of shellac, followed with a coat of white enamel. When the enamel is dry, brush bronze paint over the embossed parts of the molding then wipe dry with a cloth that is slightly dampened with paint thinner. This will tend to remove the bronze from the surface, but it will leave the depressions filled with gold for an attractive antique white finish. J.C.

See also: FINISHING, WOOD; FURNITURE, INDOOR.

MATERIALS LIST

Quantity	Size and Description	Purpose
1	1/16″ 18″x48″ laminated plastic	table top
1	1/2″ 18″x48″ fir plywood	table top
2	7/8″ 3 3/4″x24″ molding	ends
2	7/8″ 3 3/4″x50″ molding	sides
2	3/4″ 3/4″x18″ pine	cleats
2	3/4″ 3/4″x48″ pine	cleats
as needed	1″ #8 round head screws	
4	16″ tapered legs	

NOTE: Also need contact cement, white glue and finishing materials.

Book and Magazine Table

This graceful end table is easy to build and will keep books and magazines neat and near at hand

THIS GRACEFUL TABLE conveniently holds your favorite books and magazines. The interesting surfboard shape not only goes well with contemporary furniture, but a slight tilt to the end panel creates a handy book display area. Sturdy, unusual wrought iron legs add character to the low lines of this design which is easily assembled when you study the drawings and take it a step at a time.

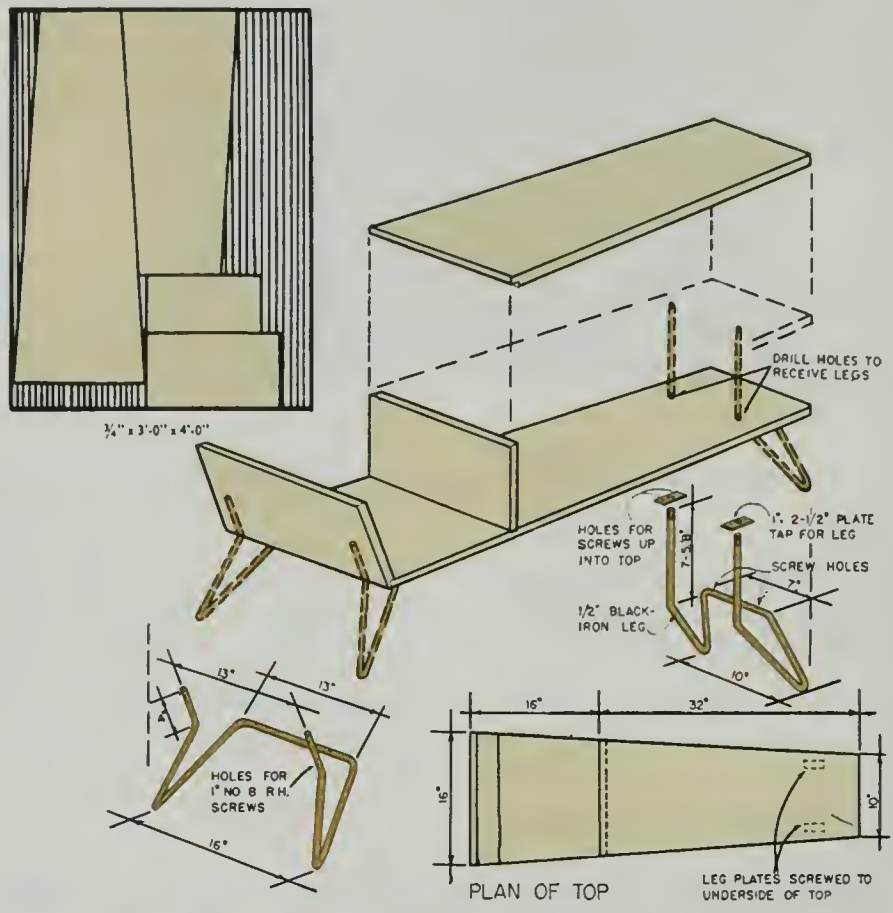
Begin by having a metal workshop fabricate the wrought iron legs according to the plan. To take care of minor variations in angles and dimensions, you probably will save yourself extra work by having the legs bent before beveling and drilling the bottom shelf and cutting the support partition for the top shelf to proper height. Paint the legs with flat black enamel or in a color to contrast with the shelves.

Using a large steel square, lay out the parts on a panel of ¾-inch thick interior-type plywood, as shown on the cutting diagram. Remember to allow for saw kerfs while laying out the parts. Next saw out all parts to size, drill holes to receive legs and then dado bottom shelf to receive the support partition. Make an angular cut on the wide end of the bottom shelf to fit the rabbet on end panel, then rabbet the end of the top shelf to receive the support partition. With glue and 6d finish nails, fasten end panel and the partition to bottom shelf. Then support the top shelf on a block while attaching to this partition. Some adjustment for length of legs can be obtained by drilling blind holes on the underside of the top shelf; plates can be threaded up or down a

few turns to bring top shelf level. Use screws to fasten leg frames and plates as shown.

Finish by smoothing edges and joints with coarse sandpaper on a block and filling nail holes and plywood edge grain with wood paste filler. Next smooth up the table with fine sandpaper, rounding sharp edges and corners slightly. Then apply an enamel undercoat followed by two coats of semi-gloss enamel.

See also: FINISHING, WOOD; FURNITURE, INDOOR.



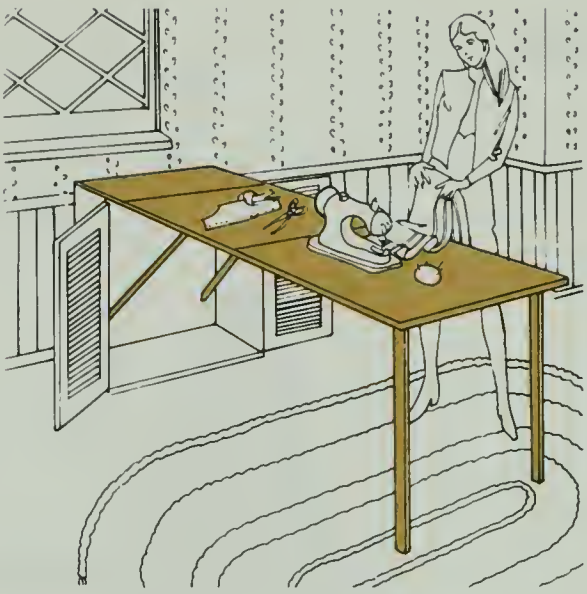
MATERIALS LIST

Quantity	Size and Description	Purpose
1	¾" 16"x44¾" interior plywood	bottom shelf
1	¾" 16"x32" interior plywood	top shelf
1	¾" 7¼"x14" interior plywood	divider
1	¾" 8½"x16" interior plywood	end
as needed	1" #8 round head screws	

NOTE: Also need wrought iron legs, leg plates, 6d finishing nails, glue and finishing materials.

How to Make a Fold-away Table

This inexpensive unit is a real space-saver. Fold it out when you want to use it, conceal it in the cabinet when you don't need it



THIS SPACE-SAVING TABLE folds away when it is not in use. It's easy to build and inexpensive—most of the parts are cut from plywood.

Start by laying out the parts on two 4 x 8-foot sheets of ¾-inch interior AB plywood, as shown in the diagrams. When the parts are cut, dado and miter the cabinet side pieces and miter the ends of the cabinet top piece. Dado the back as shown in the drawing. Miter the 1 x 2-inch cabinet facing strips and assemble the cabinet with glue and finishing nails.

Rabbet and miter the table top edging as shown in the drawings and apply it to the plywood table top. Then join the two table top sections with four Soss hinges. These are available in hardware stores, as are the E-Z folding leg brackets and the Kant-Sag steel brackets on which the inner end of the table is mounted in the cabinet.

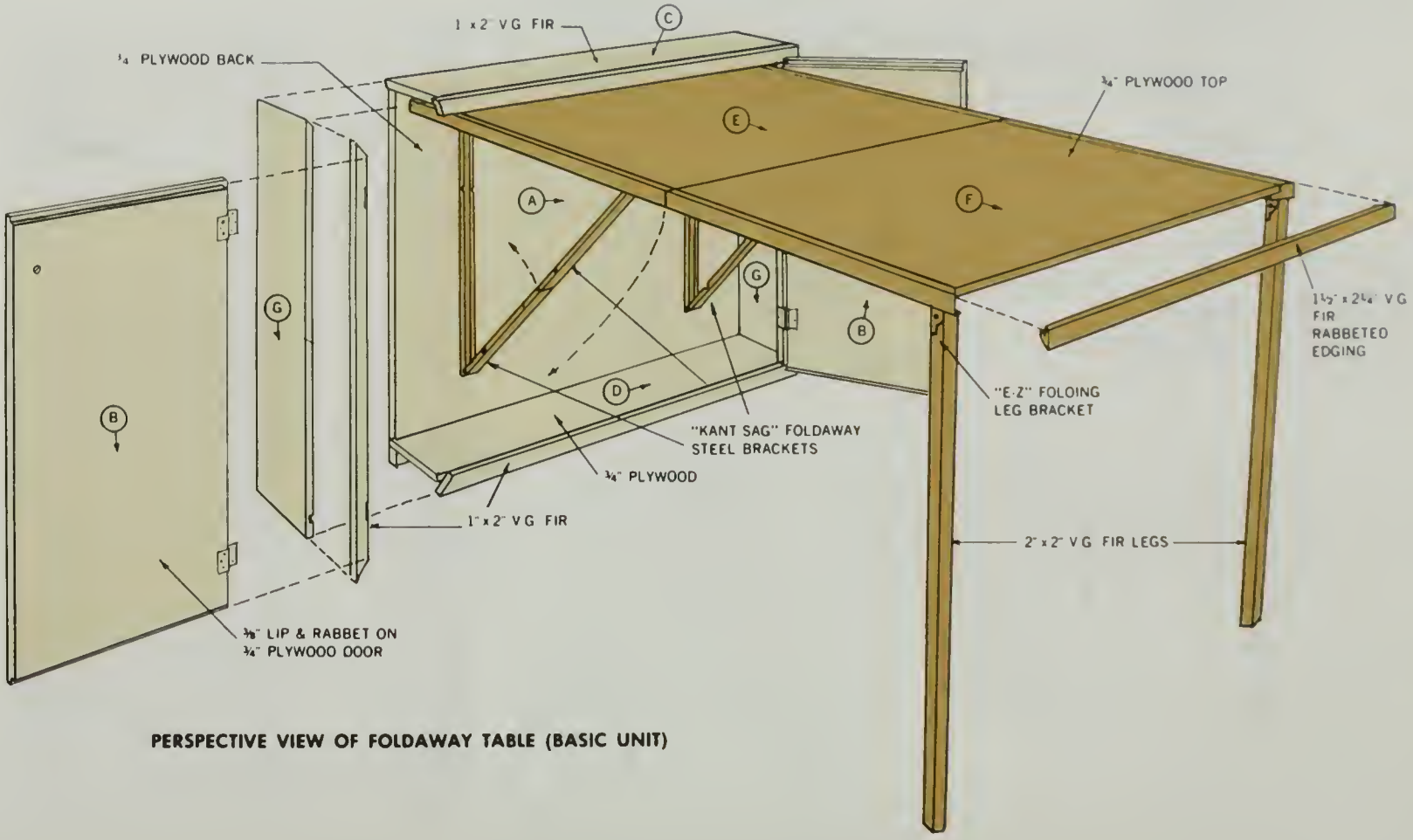
Install the Kant-Sag brackets in the cabinet, according to the instructions of the manufacturer, and attach the horizontal ends to the table top. Cut the table legs to fit and attach them to the outside end of the table with the E-Z brackets.

Rabbet the edges of the cabinet doors to

MATERIALS LIST

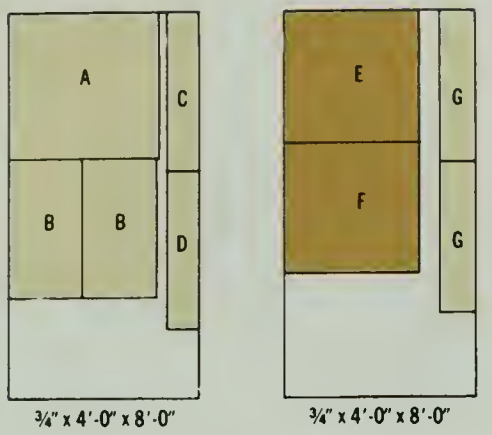
Quantity	Size and Description		Purpose
1	3/4"	37"x38 1/2" A-B interior plywood	cabinet back
2	3/4"	18 7/8"x34 1/2" A-B interior plywood	doors
1	3/4"	8 1/4"x40" A-B interior plywood	cabinet top
1	3/4"	7 7/8"x39 1/4" A-B interior plywood	cabinet bottom
1	3/4"	33"x34 1/2" A-B interior plywood	table top
1	3/4"	32 1/4"x34 1/2" A-B interior plywood	table top
2	3/4"	8 1/4"x37 3/4" A-B interior plywood	cabinet ends
1	1"	2"x16' fir	cabinet facing
1	1 1/2"	2 1/4"x15' fir	table top edging
1	2"	2"x6' fir	table legs

NOTE: Also need steel brackets, folding leg brackets, concealed hinges, semi-concealed hinges, magnetic catches, door pulls, 6d finishing nails, screws, glue and finishing materials.

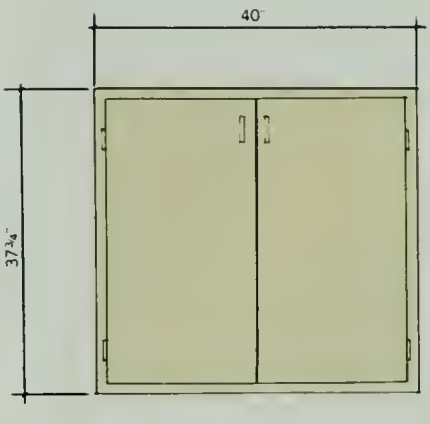


PERSPECTIVE VIEW OF FOLDAWAY TABLE (BASIC UNIT)

BASIC UNIT

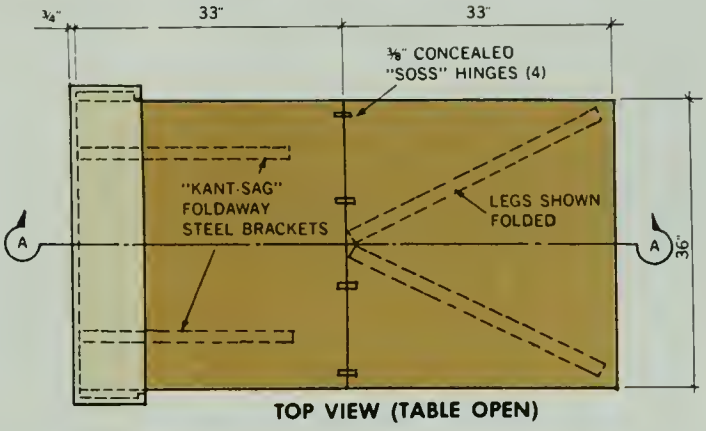


INTERIOR DFPA • A-B

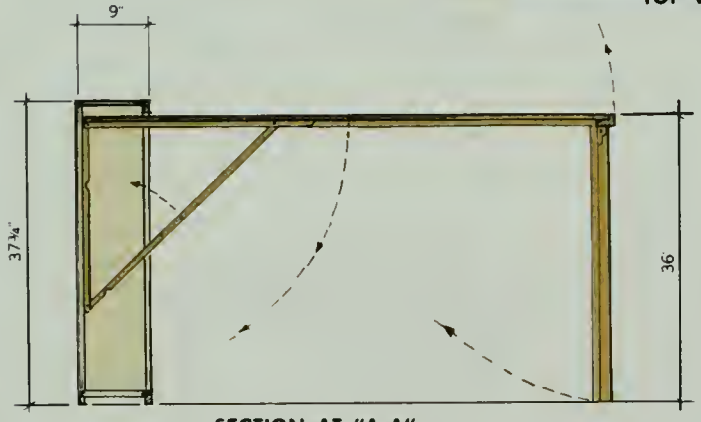


FRONT VIEW

SCALE: ½" = 1' — 0"



TOP VIEW (TABLE OPEN)



SECTION AT "A-A"

For variations of basic unit see page 2646

accommodate the cabinet lip and mount them with semi-concealed hinges—use two per side.

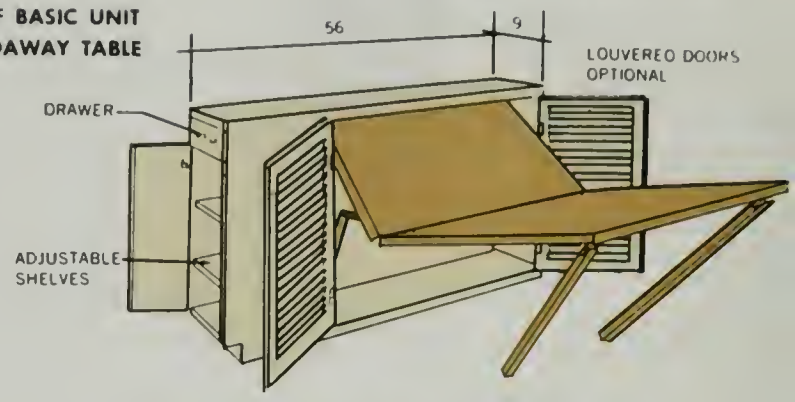
Fill all nail holes and other flaws, sand the cabinet smooth and finish it with one coat of primer and two coats of enamel.

Several variations of the table are shown and you can adapt the design in other ways to suit your needs. If you do, be sure to adjust the cutting of the parts accordingly.

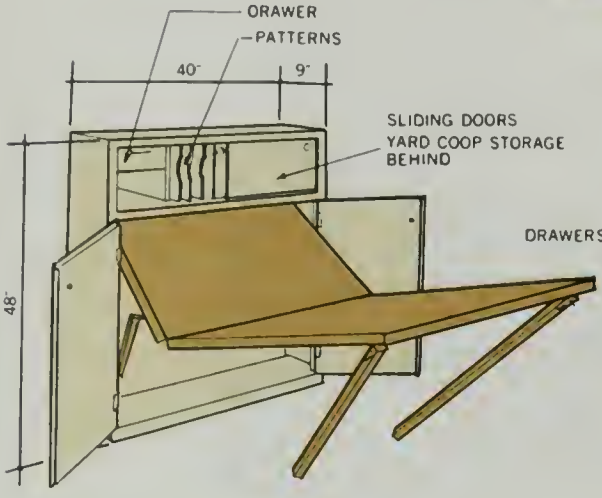
See also: FURNITURE, INDOOR; MODEL CAR LAYOUT; ROOM DIVIDERS; STORAGE; WOODWORKING.

2646 *How to Make a Fold-away Table*

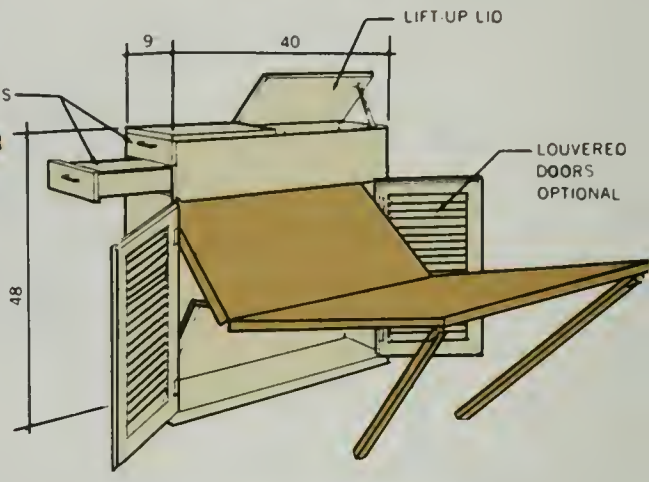
SUGGESTED VARIATIONS OF BASIC UNIT TO ADD STORAGE FOR FOLDAWAY TABLE



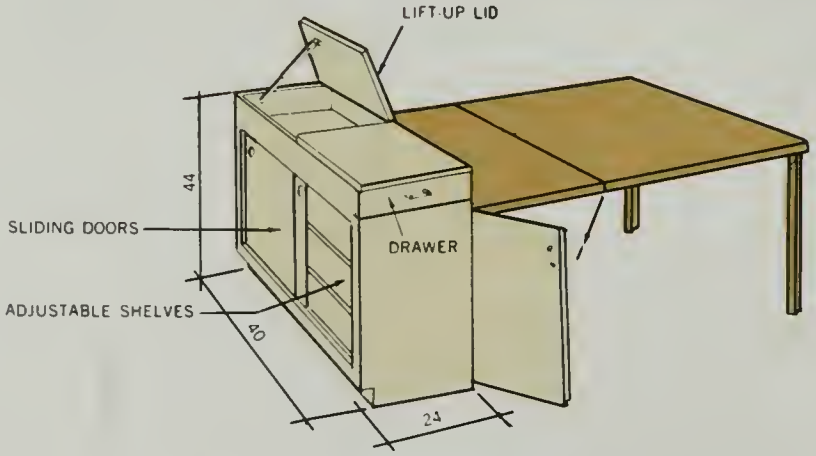
(1) WITH END STORAGE



(2) WITH SIDE STORAGE



(3) WITH END AND TOP STORAGE



(4) AS A DIVIDER WITH REAR, END AND TOP STORAGE

How to Use a Table Saw Like a Professional

Operating a table saw is simple and safe if you use it properly, and with it you can turn out more accurate work than you possibly could doing it by hand

THE TABLE SAW is an efficient and effective tool. It saves you a tremendous amount of hard labor. It can turn out work that is straighter and more precisely dimensioned than you could possibly get otherwise. And it can be operated with complete safety year after year.

A table saw (often called a bench saw or circular saw) is a power tool, not a toy. *Caution!* Use the saw correctly. It's an axiom that if you use the tool correctly, you are also using it safely.

Operating a table saw is simple and safe. The entire unit is solidly planted where it belongs. There's just a small blade rotating, most of it under the table and out of the way. Only a very small segment is exposed, usually only about an inch in height. But small as it is, the blade can wreak plenty of havoc when used carelessly or improperly.

Here are the essentials of good woodworking practices:

Have a saw of good quality and of ample size for the work to be done. The larger the table size, the better. Extra side extensions help to stabilize the wood stock as it is fed into the blade. A small table provides only a small area to hold a board steady while it is being cut. The saw fence should be of sturdy construction, with a dependable locking device, and preferably of the self-aligning type so the fence is square with the blade each time it is set.

Have adequate electric current. You can't run a motor on low current. A separate circuit to the motor is advisable so there's no voltage drop when the motor goes on, and no stalling at rough spots. Have a handy on-off switch near the saw, and an extra cut-off switch for all your shop's power tools. Make sure that the saw belt is adjusted to the correct tension.

Have sufficient clearance on all sides of the tool to handle boards without hindrance. If you're running an 8-foot long board through the blade, you need at least 16 feet of clear space, plus the width of the blade and room for yourself. If the

table saw jig: see jigs
table top loom: see looms
table top, marbleized: see painting
tachometer: see electronics
tape player: see cassette tape player

Ripping goes best when done this way; hand on stock is wrapped around fence. Other hand feeds stock forward at steady pace.

Wide stock is easy to handle; blade is shown higher than normal for plywood. The teeth should extend about 1/8-inch above plywood.

space is long and narrow, you can mount the saw on casters to turn it sidewise for crosscutting. An extra table or roller platform at the back of the saw will support the board as it comes through, making it easier and safer to handle.

Keep the shop floor clean, and have ample lighting. Sweep up sawdust and wood chips that might cause you to slip. Lights should be in a non-glare fixture, preferably fluorescent, and cover a large area. Don't let sawdust accumulate under the saw.

Use blade guard and splitter whenever possible. Have a push stick handy at all times for feeding narrow stock. Use only sharp and clean blades; dull blades require excessive pushing and make rough cuts. Keep the saw mandrel properly aligned with the blade so the stock will cut true and won't bind against the fence.

Wear proper clothing—no dangling sleeves or tie. Avoid wearing rings or wristwatch. Always stand at the side of blade when running stock, not directly in back of it. And never reach to remove waste pieces of stock when the blade is running.

Possible mishaps. It's best to be informed of possible hazards and prevent them. When something goes wrong it happens instantly—without warning. There's no time to correct errors then. Here is a list of such situations and protective measures.

1. Out-of-line ripping. When feeding a board, it should be kept in contact with the fence until the blade has made a deep cut into the stock. If the board is moving in without side support, an open space between the stock and the fence becomes larger. The board then wobbles so that the cut suddenly swerves out of line. If your fingers are nearby holding down the stock, they may be pulled into the blade. Never rip stock that does not have a straight edge to go against the fence and keep fingers wrapped tightly around the fence top.
2. Kickback. This happens most fre-

⚠ *Crosscutting of wider boards is more efficient when done on a sliding feeder table, made with double runners and back support.*

⚠ *Grooving may be done with a regular blade by moving the fence slightly after each cut in order for you to get the desired width.*

quently when ripping and the work is fed too quickly, or binds in the blade. The wood is thrown back with great force. Never stand directly in line with the blade. Hold work down firmly and use the splitter to keep kerf open.

3. Binding. This occurs when crosscutting with a blade that is dull or rusty. If the saw belt is of the right tension, the motor will stall, and it should be shut off instantly.
4. Narrow stock. Always use a push stick to feed narrow stock along the fence. When fingers must be used for holding down the wood, hook the other fingers over the top of the fence, and slide them along as the work goes through the blade.

Each sawing job calls for a special method, which should be followed scrupulously. There will be plenty of times when your inventive talents will be called on to solve special problems. That means planning and setting up jigs that hold the work securely, particularly when you cut tenons, lock miters, bevels, and irregular shapes.

Handling large panels. A common problem is that of cutting large plywood panels. A ¼-inch wallboard panel is light enough, and can be handled on a saw of average size provided you set up a table nearby for extra support, or have a roller-topped extension stand. Even with the ¼-inch stock, it's difficult enough to run the panel through and keep it always firmly against the fence.

A ¾-inch plywood panel is usually beyond the ability of a single person, and it's best to have assistance—to carry it into the workshop as well as to align it properly on the saw.

Your assistant should stand alongside the saw as the panel end approaches the blade, pressing in from the side against the fence. Both persons then slowly guide the panel along until it is halfway through, then the assistant goes to the back and supports the panel as it emerges. In the final stage, the

person feeding moves to the side and continues pressure at the side to hold the panel edge at the fence so the cut is straight and true all the way. The feeder supports the free side of the ripped panel, while the assistant pulls the other part until it clears the blade.

An easier way to handle a full-length ¾-inch panel is to precut it roughly to width with a portable circular saw or jig saw. The straight factory-cut edges on each side are retained to go against the fence for final ripping to precise size. Pre-cutting is also helpful for getting the panel into a basement workshop when the entranceway presents difficulties. Only the large, professional model saws can cut to the center of a 4-foot-wide panel, so usually this must be done with a portable saw.

Methods of ripping. Ripping is cutting in the same direction as the grain, and is always done against the fence. When ripping, always use the blade guard and splitter. The splitter prevents the wood from squeezing together at the saw kerf and thus makes it easier to feed the stock smoothly.

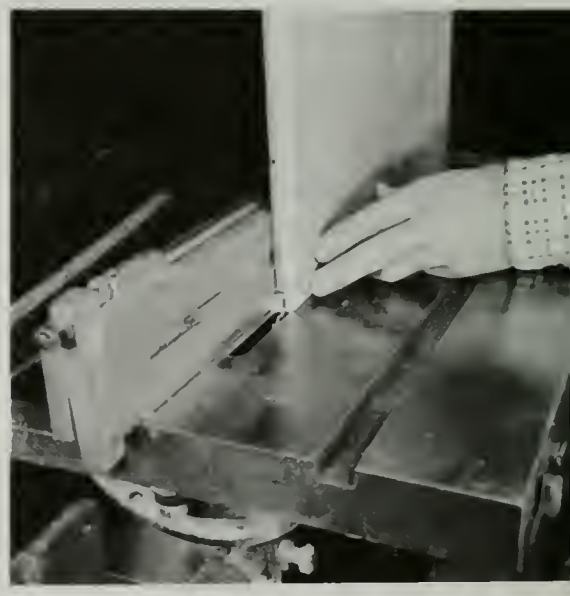
When setting the fence for the cutting width, use a folding ruler to measure the distance from the fence to the inside tip of a saw tooth that is set toward the fence. Thus you have the width that the blade will cut, and avoid including the thickness of the kerf. That is, if the stock you want is on the fence side and the waste stock outside. But it can be reversed; the outside piece can be the desired size. In that case, measure from the outside edge of a saw tooth to the edge of the wood, and the kerf will now be on the waste stock toward the fence.

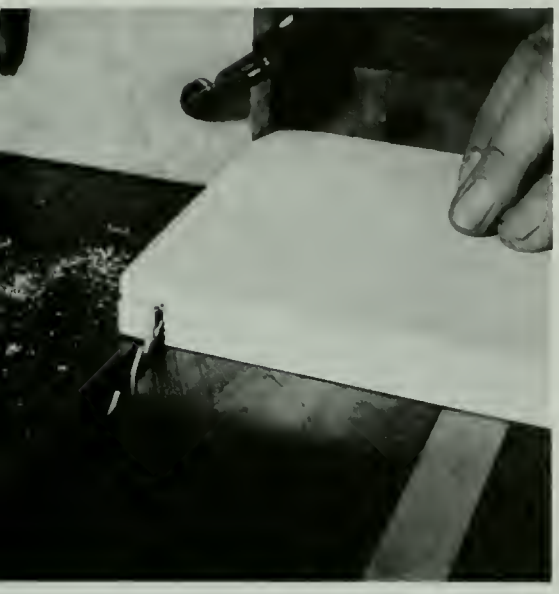
For ripping duplicate pieces to uniform width, use the fence side of the blade. This will eliminate need for measuring each time, and the dimensions will be uniform.

Adjust the blade height so it is just above the thickness of the wood. Lock the fence, making certain it won't shift. Swing the blade guard into place. Hold the board flat on the table, and advance it towards the

Dado blade is used to make wide cut at edge of board for cabinet door or drawer parts. Blades are varying thicknesses, used in a set.

Bullnose edge for cabinet door is formed by rabbeting the corner stock as shown. The rounded edge is done first with a router bit.





When rabbeting, never run stock so end rides against the fence; use extension rods on miter gauge, or clamp stop block to the table.

Molding head and cutters that are used for making cove and other shaped edges; cutters are locked in place with Allen setscrews.

blade. As it moves into the blade, place the free hand so that the thumb and forefinger are pressing down on the stock just before the blade, and holding the wood against the fence. The other fingers should be bent around the fence. In that way, if the blade should suddenly cause the wood to veer, the hand will remain safely gripping the fence, out of danger. This should be standard practice, even when the blade guard is used.

When ripping a board that is more than 6 feet long, provide support at the free end of the saw for the stock as it comes through; otherwise, you'll find the free weight pulls it down and makes it difficult to run the last part through smoothly. It is possible to walk around to the back while holding the board in place, and pull the rest of the board from there, but this is clumsy and could cause problems.

When ripping narrow stock, with less than 3 inches between the blade and the fence, always use a push stick instead of your fingers to run the wood alongside the blade near the end of the cut. When ripping thin strips at the fence side, stand well away as the strip will suddenly shoot back at your side of the table.

Taper ripping. It is possible to rip a board at an angle to make one end wider than the other. This is done with the aid of a tapering jig, consisting of two hinged boards, with a stop block on the open end of one side. The jig is opened to form an angle that will give the desired taper. It is set against the fence and the stock placed so a corner is at the stop block. The entire unit—jig and stock—is pushed through. Because of the offset formed by the open jig, the blade cuts through the stock at an angle, wider at the front than at the back. Such a jig can prove extremely handy on a wide variety of construction projects.

Miter cutting is normally done with the miter jig, which can be adjusted to any angle by loosening a thumb screw. But there's a tendency for the wood to creep slightly

while it is cut, so wherever possible, the work should be held with a C-clamp. Even so, the results may not be perfect on small work. A better method is with a large sliding panel which has two runners that move in the table slots. The work is easily held against large, correctly-positioned blocks set at 90° angles.

Crosscutting to length. The miter gauge is used when sawing work across the grain to obtain the desired length. The miter gauge should be tested occasionally to make sure it is square with the blade. The work is set against the gauge, which is moved towards the blade until the cut is made. In crosscutting, the blade guard may be a hindrance and there's the temptation to remove it entirely. But this should be done only after you have acquired experience.

If the saw table is quite small, situations may arise when you want to cut 12-inch-wide stock and there's insufficient clearance for the wood between the front edge of the blade and the miter gauge.

A solution is to lower the blade so the wood can move forward over the blade plate. While holding the stock down, start the motor and raise the blade so it cuts through; then you can push the wood through with the gauge to complete the cut.

If you want to cut a number of pieces to the same length, adjust the stop rods on the miter gauge to correct position. Then each piece is moved against the bent end of this rod and will be cut to the same length.

Another way is to clamp a stop block at the front end of the fence so that the wood can be placed on the gauge in correct position. As the wood passes the stop block, it remains in the same position for cutting. But *never* use the fence itself—or a stop block clamped near the blade—as a jig. This will cause the wood to bind and swing around out of your grasp, perhaps pulling your fingers into the blade.

When using molding shaper, always set up a supporting wall right above the cutter head. Cutter height must be precisely positioned.

When waste stock is away from the fence, find an inside tooth edge and measure to the fence; when toward, measure from outer tooth.

To bevel with tilted blade, remember distance from fence and height of blade both control position and angle of bevel; test on scrap.

Mitering jig gets top results every time because table panel moves with stock and minimizes creeping, assures accurate measure.

Rabbeting and tenoning. There are many woodworking jobs that require rabbet joints, such as drawer fronts and cabinet doors. This entails setting the blade at precise height for each of two cuts. The first cut is made with the board held vertically against the fence. Then the board is placed flat on the table with the cut end down, edge against the fence, and run through a second time, removing the square strip.

The blade height for each cut should be set first by measurement, but then tested for accuracy by running through a few pieces of waste stock. When vertical and horizontal cuts mate at the precise position to clear the edge stock, the setup is right to go ahead.

Dadoing across the grain, and grooving along the grain, are best done with an adjustable dado cutter, or a set consisting of several blades of different thickness placed together for a cut of the correct width.

Adjust the blade height by making test runs to cut the groove of the desired depth. When running the stock, hold it down firmly over the cutter, as the wood tends to bounce slightly which results in an uneven cut. When using dado blades, the table insert plate must be changed for one that has a slot wide enough for the cutter.

For tenoning, a special jig makes the job easier, as the stock usually is long and must be fed into the blade along the narrow edge. Clamps on the jig hold the stock firmly and safely.

Other cuts, like mitering of a long plywood edge for a cabinet top, compound miters for cabinet joints, spline cuts into the sides of a long miter edge, and lock miters, are quite sophisticated and require advanced skills. Each requires careful measurements and setups, but they contribute greatly to your woodworking projects, and are worth learning. The chart shown here

should prove helpful as permanent reference.

Half-lap joints, used for making frames for boxes or screens, bring two parts together, each of which has been cut to half the thickness of the wood so the corners match evenly and flush. The cutting is done against the miter gauge, either with a dado blade or a regular crosscut blade. It is essential that the blade height be precisely at half point. As the dado blade will not be of the correct thickness, the work must be shifted while making several passes across the blade to obtain a sufficient width of cut. Because of this, the use of a regular blade is suggested.

First place the two pieces to be joined so the corners are square to each other. With a pencil, mark lines at the inside edge on each part. After the blade is set to correct height, half the thickness of the work, make the first cut on the inside of the marked line. Then move the stock about ⅛-inch closer to the blade and repeat the pass, thus widening the kerf. Repeated passes, while moving the stock about ⅛-inch each time, will complete the lap cutting.

Repeat this with the other part, and fit the two pieces of stock together. In most cases, the cleared section must be smoothed with the edge of a chisel to clean out loose fibers. The half-lap joint must fit perfectly flush on all sides.

Other types of joints that are useful, but too complex to detail here, are the tongue-and-groove, dovetail, lapped miter, tenon, lock miter, scarf, and blind tenon. Coves and other moldings are made with a molding head that takes a set of cutters in the required shapes. This work is done with special jig holddowns, and should be tackled only after considerable experience.

Beveling and chamfering are done by tilting the saw (or the table) to the required angle. Position of the fence will control the depth of the bevel cut. When a full 90° angle is desired, as for a mitered cabinet top, a strip of wood is clamped to the fence to provide a soft facing. Then the tilted saw blade is raised while it is running, until it just begins to bite into the extra fence facing.

If the fence is positioned correctly, the blade just misses the top edge of the board, or the veneer if it is plywood. A few test cuts will be necessary to make the final adjustment in both fence and blade height so the mitered corners will fit precisely.

Getting a straight edge. It's not the fancy cuts that will give you trouble, so much as the ordinary, everyday situations. You may have perfectly good pieces of solid maple stock that would be just right for a desk frame, but have rough, uneven edges. How do you get them straight enough so they can be ripped on the table saw? This is a common problem because many of the hardwoods are sold that way, in random widths and with very uneven sides.

The solution is easy if you have a jointer —in fact, that's a prime purpose of the jointer. The board is run through the rotary cutters until the sides are perfectly straight and smooth. Another way, but much slower and more difficult, is to plane the board by hand, checking with a square until it is true. Or you might try tacking the maple to another thin, straight board, setting the edge a little distance from the fence, so that as the bottom board moves along, the blade also cuts into the hardwood and forms a new straight edge.

Sawing plastic veneers. When sawing plastic laminate sheeting (Formica, Micarta, etc.) on a table saw, always keep it face up to prevent chipping of the plastic coating at the edges. When cutting the thin plastic itself, feed slowly while holding the stock down close to the blade with a flat piece of wood to prevent bouncing. It is easier to saw when the plastic has already been laminated to a plywood backing.

When cutting plastic with a portable power saw, turn it face down, as this type of

saw revolves the opposite way. The saw teeth must cut from the finished side down.

When sawing the plastic, or tempered hardboard, use a carbide-tipped blade or special hardened metal-cutting blade. A regular blade can be used, but it will quickly become dull.

Correcting saw troubles. Burning, which scorches the sides of the stock and sometimes causes smoke, is due either to a dull blade or green wood. Some of the hardwoods, particularly birch, are very difficult to cut on small-diameter home saws. If your saw has variable feed pulleys, set the belt for lower rpm. If gum or resins accumulate on the blade and make it sticky, wash it with turpentine or other solvent. Raising the height of the blade about ¾-inch above the thickness of the stock often will make cutting easier.

When the blade binds in the kerf, use the splitter to keep the kerf open. Binding may occur near the end when ripping a long board, because of the weight at the far end or possible twisting as a result of misalignment. Supporting the board with a table will correct this problem and make handling easier. R.T.

See also: HOPPERS; JIGS; POWER TOOLS; RADIAL ARM SAW; SAW; TOOL TECHNIQUES; WOODWORKING.

Edge slotting may be done by holding board upright, but there's tendency to wobble. A tenoning jig is the effective, quickest method.

TABLE AND GAUGE SETTINGS FOR COMPOUND ANGLE CUTS

Work Angle	4-Sided Butt Joint		4-Sided Miter Joint		Hexagonal Joint		Octagonal Joint	
	Blade or Table Tilt	Miter Gauge	Blade or Table Tilt	Miter Gauge	Blade or Table Tilt	Miter Gauge	Blade or Table Tilt	Miter Gauge
5°	1/2	85	44 3/4	85	29 3/4	87 1/2	22 1/4	88
10°	1 1/2	80 1/4	44 1/4	80 1/4	29 1/2	84 1/2	22	86
15°	3 3/4	75 1/2	43 1/4	75 1/2	29	81 3/4	21 1/4	84
20°	6 1/4	71	42	71	28 1/4	79	21	82
25°	10	67	40	67	27 1/4	76 1/2	20 1/4	80
30°	14 1/2	63 1/2	37 3/4	63 1/2	26	74	19 1/4	78 1/4
35°	19 1/2	60 1/4	35 1/4	60 1/4	24 1/2	71 3/4	18 1/4	76 3/4
40°	24 1/2	57 1/4	32 3/4	57 1/4	22 3/4	69 3/4	17	75
45°	30	54 3/4	30	54 3/4	21	67 3/4	15 3/4	73 3/4
50°	36	52 1/2	27	52 1/2	19	66 1/4	14 1/4	72 1/2
55°	42	50 3/4	24	50 3/4	16 3/4	44 3/4	12 3/4	71 1/4
60°	48	49	21	49	14 1/2	63 1/2	11	70 1/4

Figures are in degrees and are for direct setting to tilt scale and miter gauge. Scale providing tilt starts at 0° and miter gauge at 90° in normal position.

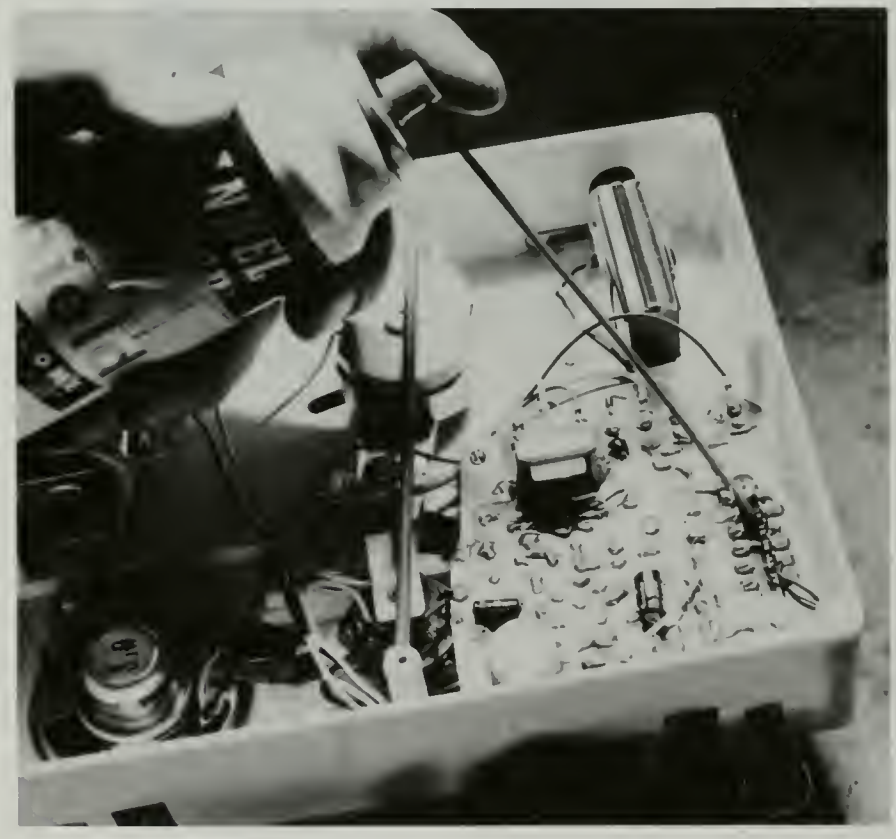
Solving Minor Tape Recorder Problems

You can save repair bills for your tape recorder by identifying and solving minor problems yourself

YOU CAN CUT SERVICE CALLS by making minor recorder repairs yourself. The photographs shown present common tape recorder ills, with the suggested remedy in each case.

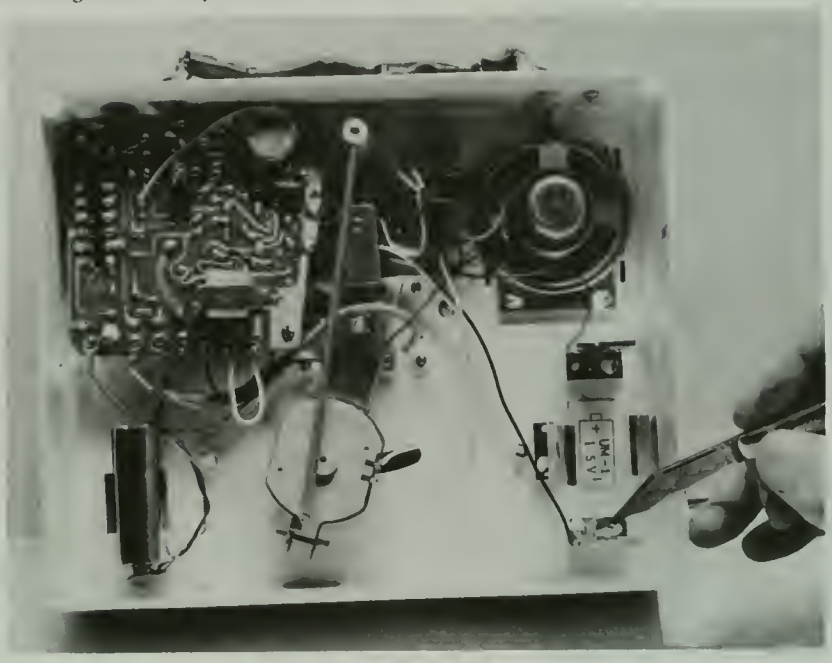
H.L.D.

See also: CASSETTE TAPE PLAYER; ELECTRONICS.

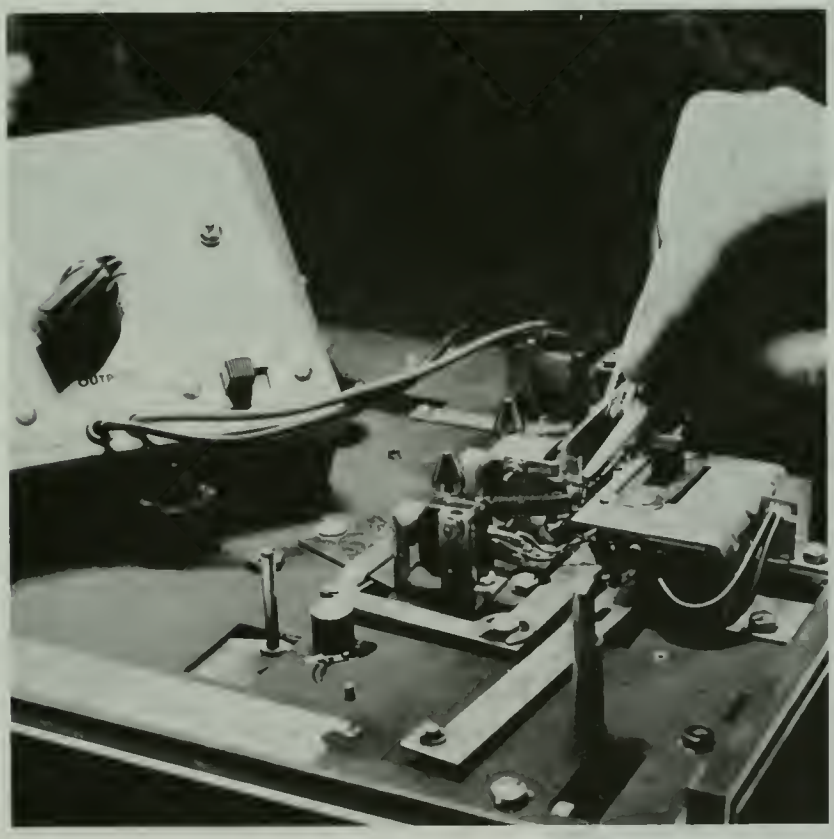


Use a spray lubricant to oil all switching contacts and motor bearings. Oil all moving parts, but use the spray can sparingly. Check the switch back and forth when oiling and also let the motor turn over a few times. Wipe off any oil that may run or drip upon the pulley belts, pulley, or rubber wheels.

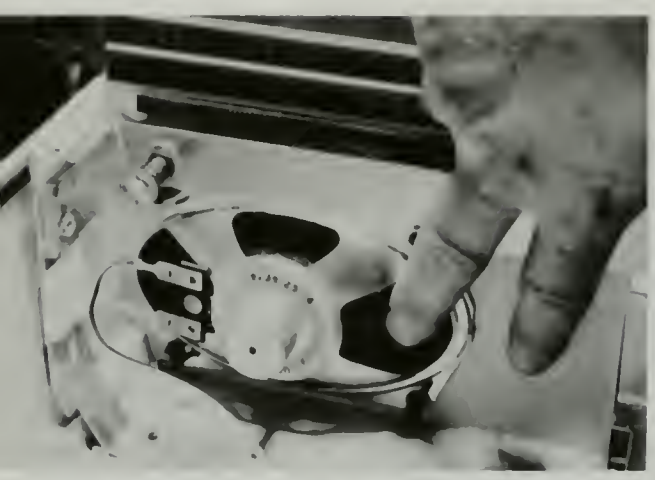
tapered columns: see hoppers
tapering jig: see jigs
tappets: see engine
tax shelters: see home ownership



If the battery tape recorder has intermittent sound and will only work part time, check the batteries and battery terminals. Do not leave batteries in a portable tape recorder over any length of time. Make a habit of installing new ones every four or five months. Check the batteries in a battery checker or substitute new ones. Take a good look at those battery terminals. If they are corroded and have bad connection spots, file them down. Sometimes only a pocket knife is needed to put the corroded battery terminals back in shape. Clean up all battery terminals and bend them back into position. Knife here points to corroded terminals.

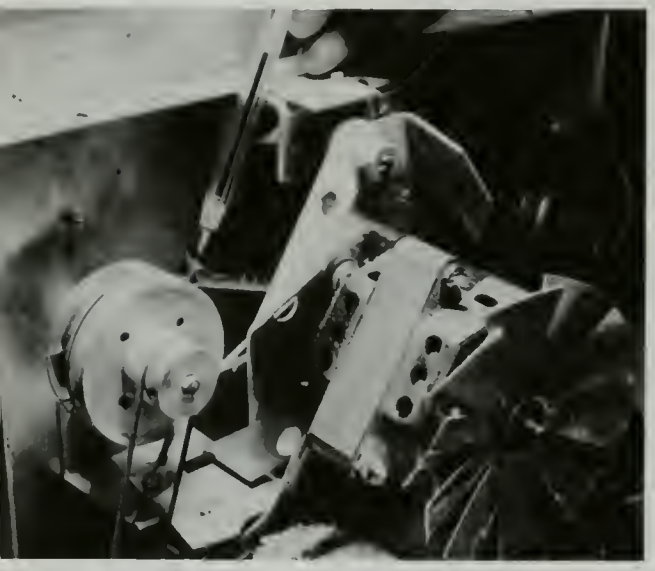


No sound? Take a signal generator and see if the audio amplifier is working. First remove the tape reels and plastic head protector from the top of the tape recorder. Unhook the green wire going to the playback head and clip one side of the signal generator to it. Ground the common black wire to the amplifier chassis. Turn the tape recorder to play position and turn the volume wide open. You should hear a high pitch note in the amplifier speaker. If this is so, the playback or recording head is defective. The meter, or neon indicating light, will flash off and on if the tape recorder is recording properly.

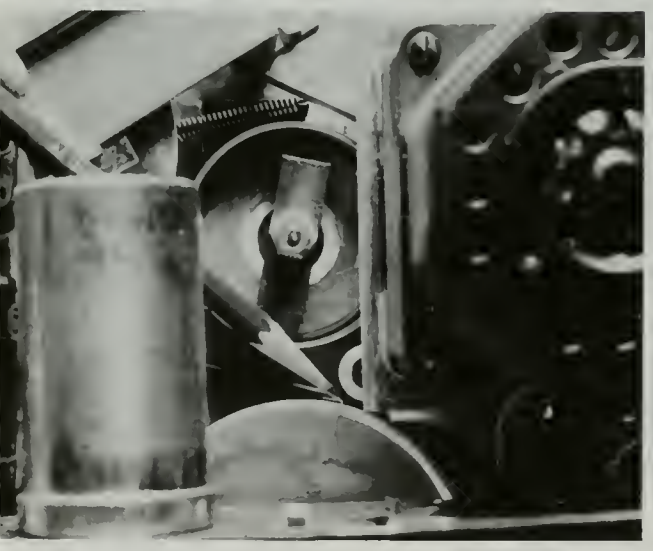


Solving Minor Tape Recorder Problems

Does your tape recorder heve a tinny or mushy sound? Take a quick glance at the smell speaker. Meny times the speeker coil will drop down against the center pole end the music will become mushy. Take your tinger end push in either side of the coil and see it the music becomes cleer. It so, the speeker should be repleced. It the speaker cone is loose or hes a few holes in it there will be a loose vibretion sound. A loose spider ring in the speeker will cause bletting on bess notes. Check around the spider ring and see it it hes become unglued. Use regular speaker cement around the outside ot the spider ring. Also check the ring eround the top of the cone to see it it is loose and vibreting. Reglue the cardboard ring back in place.



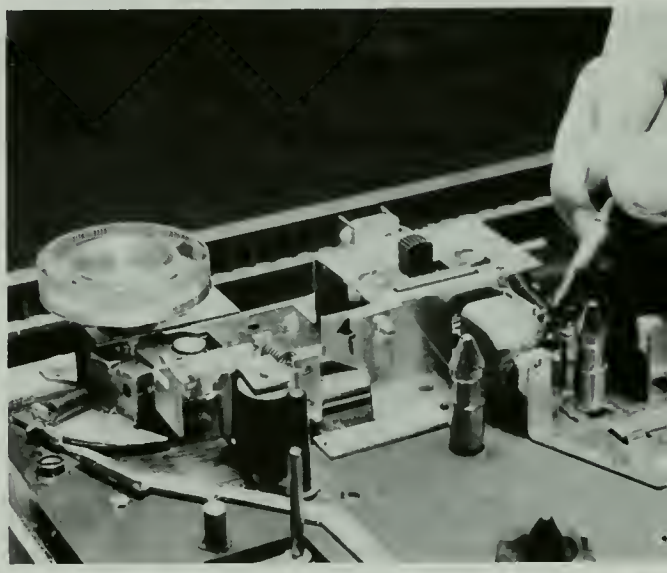
It the tape playback seems to be running quite slowly, check the drive belt. The drive belt may be slipping on the large tape drum. A worn, frayed, or cracked belt should be replaced. Also check the large and small motor pulley for excessive oil that may have dripped upon it. Clean the belt track with cleaning fluid. Check the large type pulley for a dry bearing. These large pulley wheels should spin freely.



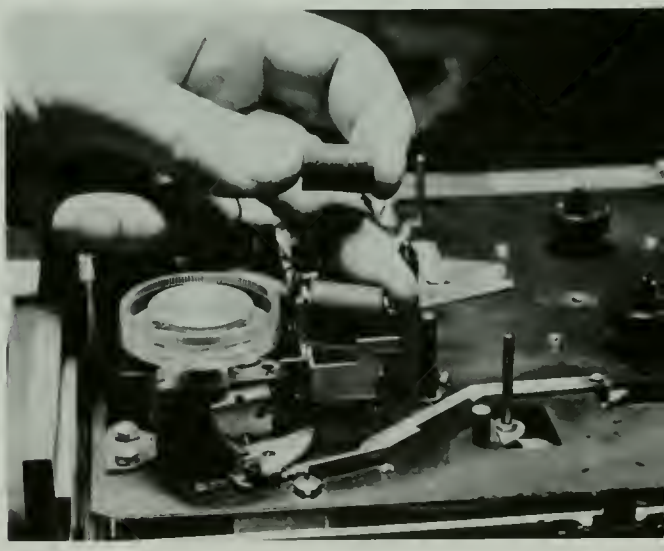
When your tape recorder is thrown to "rewind" or "record" position and there is little or no reel motion, check for a bad drive pulley or a bent lever. Many times after the tape recorder has had several years of hard use the motion levers will become bent. This is especially true under pressure such as a recording or rewind position. Photo shows a portable tape recorder that would not rewind. The lever pushing the motor drive wheel against the large pulley became bent and the drive pulley was at least 1/8-inch away from the friction drive point.

Solving Minor Tape Recorder Problems

➤ *In some small battery tape recorders the drive pulley turns against the outside of the tape wheels. When the motor drive pulley becomes shiny or worn there is a certain amount of slippage at this point. On difficult slow motor drive assembly use rosin or phono magic to prevent speed slippage. Check the large rubber tape wheels for smooth or dented edges. A dented tape wheel will cause distortion and rumbling sounds. If the flashlight batteries in the small portable tape recorder become weak, the motor speed will also be down. Be sure to check the batteries the first thing. Check to see if the motor is properly oiled. Wipe off any excess oil, so it will not run up to the tape motor pulley and cause friction slippage.*

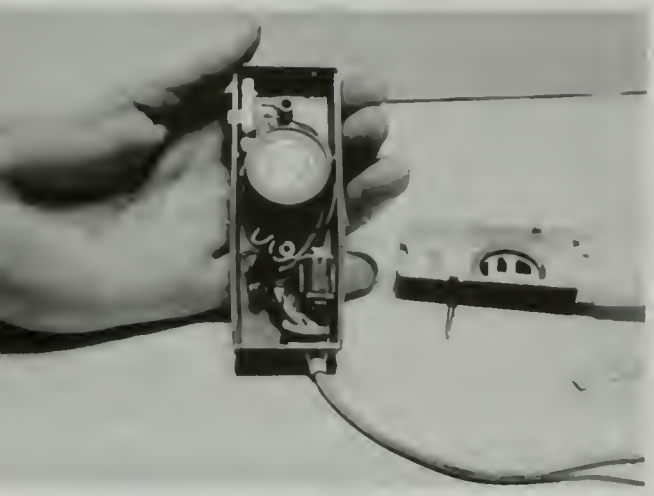


➤ *Does your tape recorder sound distorted, weak, and noisy? Check the condition of the recording-playback head. Use a small artist's brush or felt cleaner and remove all tape residue, dirt, and lint from the tape head. It may be necessary on difficult stains to rub with a soft cloth and isopropyl alcohol. At the same time check the felt pressure pads and clean them. If the pads have become quite hard, replace them. Check the tape guides for rough edges and wipe off with cleaning fluid. Demagnetize the recording head when the tape recording becomes quite noisy. Use a commercial demagnetizing tool or simply hold the soldering gun near the tape head. Also demagnetize the reel of tape for cross- or double-talk.*

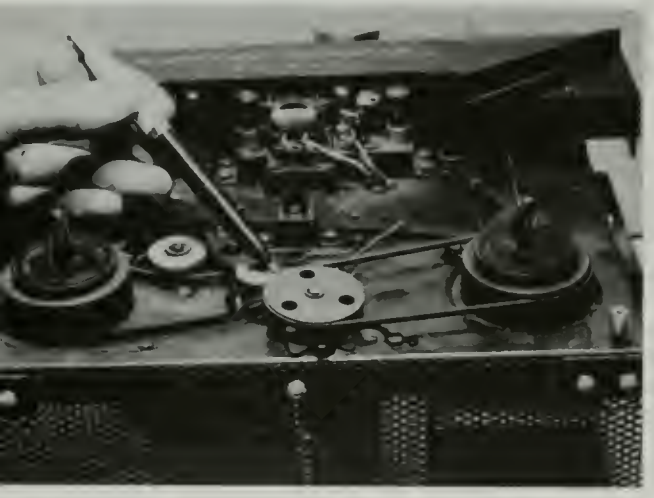


➤ *A worn rubber pressure roller and rough tape guides will cause a slipping, jerky motion of the tape. Check the tape guides and rubber pressure rollers. You will generally see a worn spot on the outside of the rubber pulley. Also, evidence of small rubber filings will lay at the bottom of the pressure roller assembly. If the rubber pressure roller is worn quite badly, put on a new one. This can be ordered from a local tape supply dealer. Be sure to take the part number and model number of the tape recorder with you. This information comes packaged with a new tape recorder. Don't throw it away. Check and see if the rubber pressure rollers will spin freely. A little oil may be needed on the brass bearings. Clean off all brown tape residue from the rubber rollers.*

2660 *Solving Minor Tape Recorder Problems*



A defective or broken microphone cord can cause intermittent recording. If one wire of the cable is broken, the microphone may be dead. Check for broken wire where the cord just goes into the microphone and microphone plug. Look at the recording indicator, while talking, and then bend the cable back and forth at the suspecting places. The meter needle or neon light will go off or on when the bad connection is made. If the recording microphone has a start and stop switch for the battery recorder, check the switch and corresponding wire for dead motor operation. Use an ohmmeter to check continuity of the switch and cord.



Is the rewinding of the tape real slow or doesn't it rewind at all? Check the batteries or motor drive pulley in the small battery portable recorders. In the larger tape models, the motor drive pulley generally pushes against the rewind drive wheel. The small friction drive on the rewind pulley makes the rewinding reel run quite fast. Check and see if the drive motor pulley is solidly against the rewind pulley. Also check and see if the rewind pulley assembly may be bent upward or out of place so the motor drive pulley does not lay solidly against it. This photograph shows the rewind pulley bent upward, not touching the motor drive pulley.

One of the biggest troubles with a tape recorder is the tape itself. The tape can become ragged, torn, or will tear right in two. Use a tape splice kit to get the broken pieces back on the track. Be sure to rewind the tape so the shiny side of the tape is on the outside. The dull side of the tape goes against the recording head. If not, you will not receive any tape recording or playback from the tape machine. Check the tape and see if it is threading correctly. This is the first item to check when you receive no playback or recording from the tape reel. Tape must be fully erased, if recording is to be clean and unblemished.

All about Recorded Tapes

How to listen and detect flaws in the recorded tapes you buy for your sound system

FIRST OFF, THE TERM "PRE-RECORDED" is a misnomer, even if it is a time-honored one. Tapes are either "recorded" (they have some information on them) or "unrecorded" or "blank" (they have no information). "Pre-recorded" is generally used to distinguish professionally duplicated tapes which you buy already recorded from tapes you record yourself. Nevertheless when you come to play them, all tapes are "recorded."

Basic formats. As you know, tapes come in three basic formats: open-reel, eight-track cartridge, and cassette. Most of the recording problems are common to all three types although their severity may vary from format to format. The cartridge and cassette are subject to mechanical problems such as tape binding, slowing down or stopping, from which the open-reel type escapes. Occasionally you'll find a cassette that will play all right in either direction but binds in fast forward or rewind. This usually happens with extra-long-playing ones and comes from a combination of a large pack of very thin tape and a less-than-ideal slip-liner. Each of the tape-packs in the cassette rests on a slippery liner against which it rubs as it turns. There are different grades of liners and you're more likely to have a bound cassette when a cheap one is used. This is something you don't see from the outside but nevertheless it affects the overall product quality.

Binding. Eight-track cartridges are even more prone to binding. They're made of an endless loop of tape wound on a hub. The tape is pulled from the center and wound on to the outside. As it plays, every layer of tape has to slip against its neighbors. It wouldn't work at all except for the lubricant that is applied to the back side of the tape during manufacture. Again there is a difference in the quality of lubricants and it shows up in performance. What is needed is one that keeps its lubrication properties without rubbing off on the oxide side of the tape and in general dirtying the head in the player. Another little thing that affects the life of a cartridge is the amount of slack in the pack. If the pack is wound too tightly, it eventually can't slip and it binds. If it's too loose, it will get out of kilter during handling. Again, this is something you can't see from the outside but it's where care in manufacture counts.

Misguiding. There are several mechanical problems that affect the open-reel tapes as well as cassettes and cartridges. One such is edge damage. Due to mishandling or misguiding in the recording or reproducing process, it is possible to permanently deform the edge of the tape. The mylar backing gets stretched and the tape edge looks rippled. Since the music is recorded right up to the edge, the deformity causes a loss of one channel periodically or, in less severe cases, periodic loss of highs on one channel. Interestingly, you're more likely to hear the effect on high-quality decks. Low-priced units almost invariably use pressure pads to keep the tape in contact with the heads. This approach, although it does tend to increase head wear and flutter, reduces the edge-waver problem.

Misguiding or edge damage can happen to any format tape during professional re-

cording. Cassettes and cartridges are less likely to experience user damage because they are protected by their case, but their slower speeds emphasize whatever problems there might be.

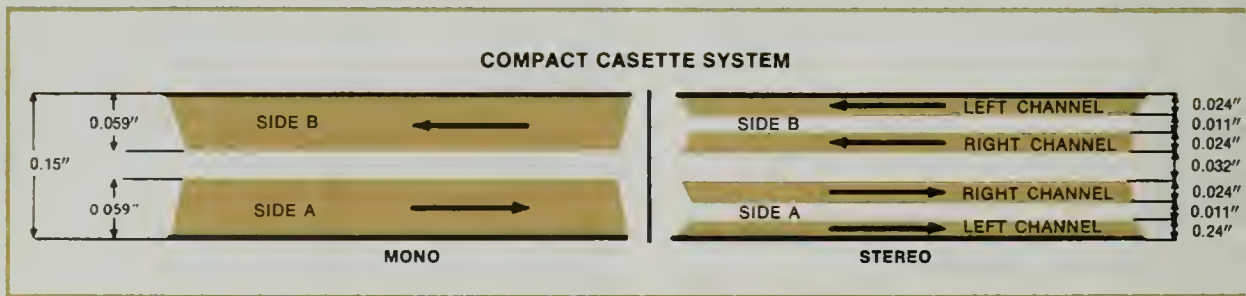
Misguiding during recording and playback will also cause crosstalk. This happens if the tape shifts slightly so the head tracks are recording or playing back a portion of the "wrong" channel; that is, one with another program on it. There is a difference between the formats in this regard. Eight-track cartridges have the narrowest tracks and the most closely spaced ones. They're most prone to crosstalk. Cassettes have narrow tracks too but Philips, the inventor of the cassette, showed good judgment in establishing the format. The stereo pair of tracks are close to each other but not close to the other program pair. Misguiding may cause some stereo crosstalk but this will generally go unnoticed. Hearing the other program is highly unlikely. Open-reel tapes have an equally spaced format, like cartridges, but the wider track widths and larger spacing generally provide sufficient safety.

Wow level. An annoying wow level can also be a problem. It may have been recorded right on the tape during manufacture but it is at least equally likely to be due to your player. Make sure it's not at fault by playing the tape on another machine. It's embarrassing to return a tape to a dealer only to find it works fine on his equipment. When the wow is the fault of the tape, it may have come about during the duplication process or it may be a sign of a binding or dragging cartridge or cassette.

Mechanical problems are more obvious than electrical ones—the tape won't move, or moves erratically, or has horrible wow (the same problem, in decreasing order of magnitude) or a channel keeps dropping out. Electrically the tape might be hissier than you'd like, or the tonal balance might seem strange or maybe the distortion or dropout level seems excessive, but these tend to be more subtle, more subjective problems. (Occasionally the wrong label is put on or there is no program at all. These are also obvious faults.)

Your player. What can you expect in the way of frequency response, noise, distortion and dropouts? A lot depends on your player. Generally, a high-quality pre-recorded tape will tax the reproduction ability of most players. That's not to say all pre-recorded tapes are of this quality or that you can't do a better recording job yourself on a new top-of-the-line cassette recorder using a quality tape, a live source,

The 0.059-inch track used in monaural cassettes is split into two 0.024-inch tracks for stereo left and right channels. The total width of the two stereo tracks, plus the 0.011-inch inter-channel space, is equal to the width of the monaural tracks. Thus, when a stereo cassette is played on a monaural recorder, it is compatible; there is automatic mixing of the left and right channels, providing monaural reproduction. The tracks of cartridge and open-reel tapes are equally spaced.

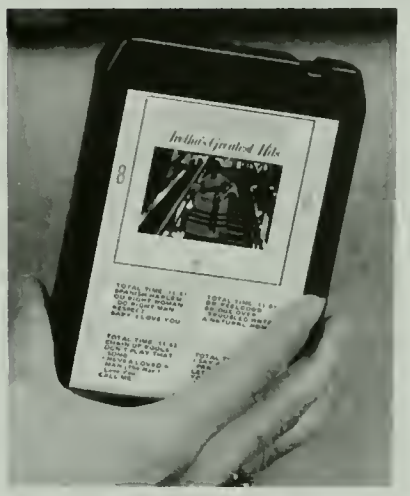


good microphones and some recording experience. Don't forget—the pre-recorded tape you buy has been mass-duplicated on conventional tape at high-speed from a master at least one or two generations removed from the original. It is a tribute to the tape-duplication industry that they have been able to develop the equipment, techniques and quality control to produce a product as convenient as a cassette and at a price competitive with that of a record.

Adjusting the electrical parameters of a tape "dupe" is an exercise in juggling. As you increase the recording level, the apparent hiss gets less because the user turns down his volume control to get the same maximum sound level. But distortion gets worse and the high frequencies tend to overload, resulting in a "mushy" lack of clarity. "S"s sound sibilant—like escaping gas. Cymbals are dulled and the brightness disappears. Higher quality tape helps and the newer cassette formulations have allowed an increase in recording level without letting distortion get out of hand.

Compression. The improved tapes appeared in the cassette format first because the situation was most critical there. The narrow track widths and slow playing speed make the job of getting a wide-dynamic-range program on the tape very difficult. Traditionally in the rock and pop field the music is highly compressed. This means that the dynamic range is very limited—there isn't much difference in loudness between the loudest passages and the softest. In effect, it's always loud. This is the way the musicians and producers want the product to sound. Some people think that this type of sound is hard to record. Actually just the opposite is true. Since you can count on the music never to get soft and reveal the underlying hiss, you can record at lower levels and preserve the high-end response while keeping the distortion down.

Classical music is a different story however. A string quartet has a much wider



range of loudness than a rock group. In order to handle the fortissimo passages the maximum level must be held down. Then when the cello bows pianissimo the hiss is painfully obvious. Electronic compressors have been used to reduce the dynamic range. These are something like automatic volume controls to turn the recording level down during the fortissimos and up during the pianissimos. The range is artifically compressed to fit on the medium. But had the performers wanted to sound that way they would have played that way, limiting their range from piano to forte. Interpretive distortion is being traded for electrical distortion. You can hear excessive compression in the music and it is cause for criticism.

A few years back a noise reduction technique was developed by Dr. Ray Dolby. At first it was applied only to professional recorders but now a consumer version is coming into widespread use for cassettes. Several of the leading recording companies are producing cassettes using this technique and when played on a quality deck equipped with Dolby circuitry the results are amazing. The noise level is reduced to the vanishing point, even with reasonably low recording levels. This gives you a quiet, wide-range, low-distortion cassette product that many critical listeners will judge superior to an open-reel tape. Of course the same technique can be applied to open-reel tapes but because the demand is low, progress hasn't been as rapid in this area. Eight-track cartridges could be Dolbyized too, but because they are mainly used as an automobile sound system, noise is not too critical. The background road noise drowns out the tape noise.

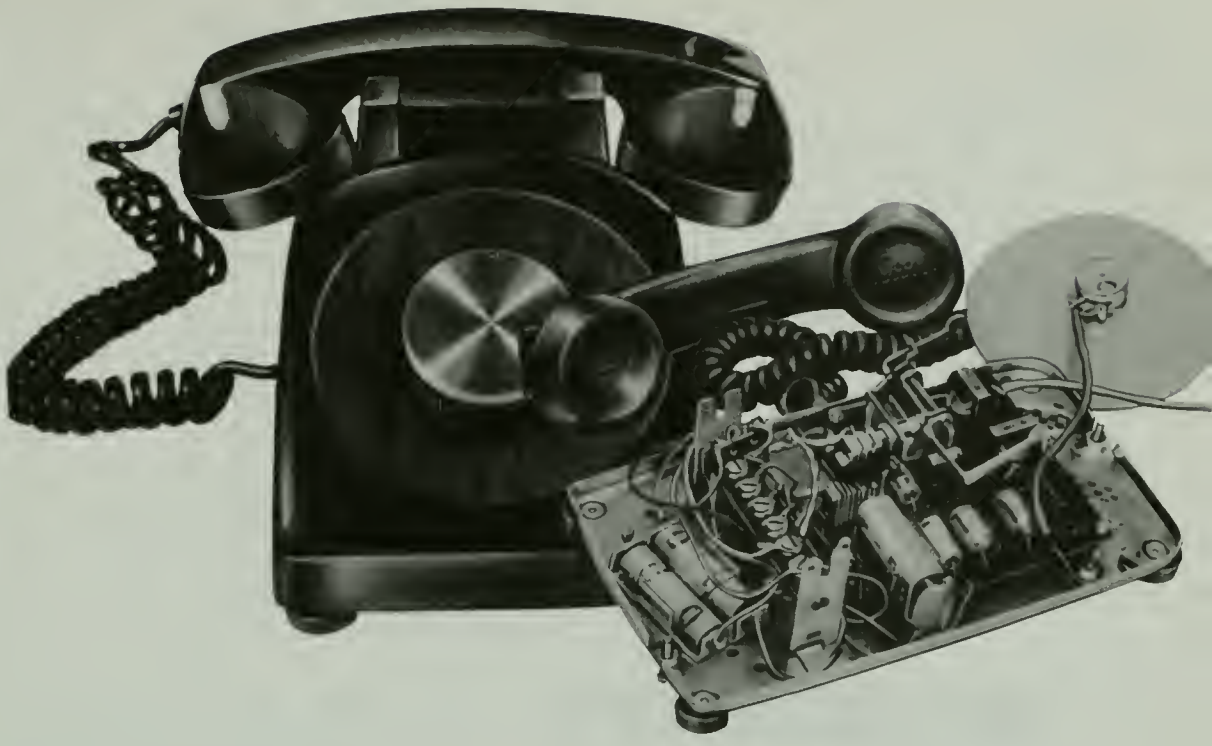
Some companies are concerned with the way a Dolbyized product sounds on a conventional player. Under these circumstances the sound is slightly "bright" since low-level, high-frequency signals are boosted by the Dolby processor. Frequently the consumer is warned to turn down the treble slightly when playing a Dolbyized cassette on a conventional player. While this doesn't fully restore the tonal balance, it helps. Tests that were conducted to establish consumer reaction to a Dolbyized product played on a conventional deck showed that most people preferred the extra bright sound to a regular cassette. Thus, Dolby seems to have an advantage even if it is not played on machines equipped with the complimentary circuitry.

Although the Dolby system has provided a breakthrough in eliminating conventional hiss, there is another kind of noise you may have heard. Technically it's called modulation noise. Unlike conventional noise, this one varies with the signal level. The louder the signal, the louder the noise. It gives the sound a fuzzy or hairy quality at all loudness levels. Its cause can be traced to inferior tape or poorly maintained equipment. You're most likely to run into it on bargain cassettes or on triple-play cassettes. The tape formulations for these triple-play units is just not up to what can be done on thicker tapes.

Dropouts. These are momentary signal losses due to dirt particles separating the tape from the recording or playback head or to voids in the oxide coating. Low-grade tapes tend to shed their oxide more than high-quality ones. This increases the dirt problem and the likelihood of dropouts. You can cause them yourself by a dirty player or by fingerprinting the tape.

When listening to a tape for a critical evaluation, be sure your equipment is up to par. Handle the tapes with care. Keep them clean and away from stray magnetic fields. The quality level of major label tapes has been excellent and improving steadily. Occasionally you're bound to find a defective tape. Your dealer will exchange it for you, but try to be sure it's a manufacturing defect, not a user one. A.N.R.

See also: CASSETTE TAPE PLAYER; ELECTRONICS.



Guard Your Telephone Privacy with a Scrambler

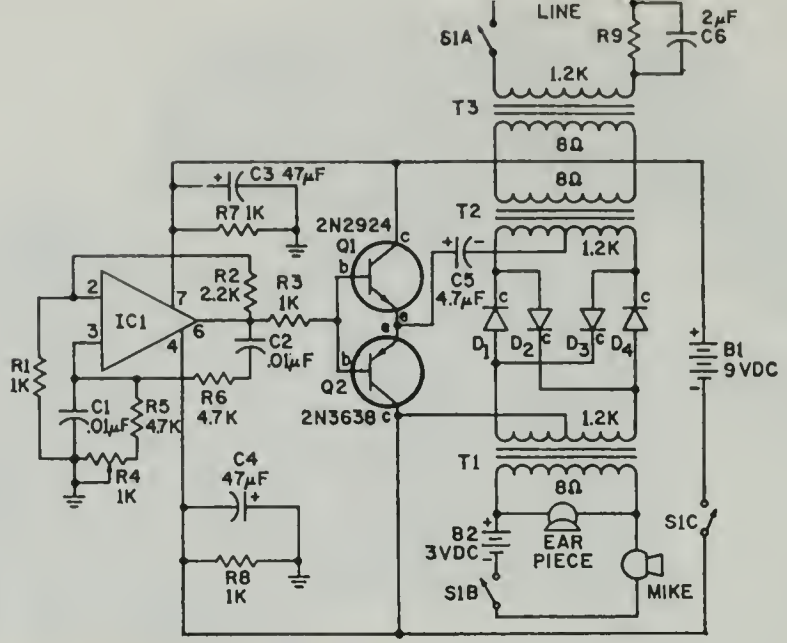
With a pair of these devices, you and a friend can talk without fear of being overheard—or at least understood—by anyone listening on an extension

DEMAND ULTIMATE PRIVACY in your telephone conversations? If so, a secure phone link can be yours with these three easy and exciting steps. 1. Place your call. 2. When your party answers, switch to your special scrambler phones. 3. A soft buzz in the ear piece says your security phone link is operational. Your line is secure. Conduct your call in complete privacy no matter how many ears are party-line-listening!

All it takes is a pair of scramble phones. And with this double-duty unit, you can try your hand at decoding scrambled conversations that are sometimes heard on radio receivers covering the VHF high band (148-176 MHz). The basic scrambler circuit can be simply modified for radio by removing two fixed resistors and replacing them with a dual-potentiometer.

This scrambler will decode information that is encoded in the single inversion mode only. The highly sophisticated scramblers that are sometimes used today can not be decoded with this decoder, but in many areas the single inversion system is still in use and may be decoded with this unit.

television, color: see color television
television, portable: see television repair

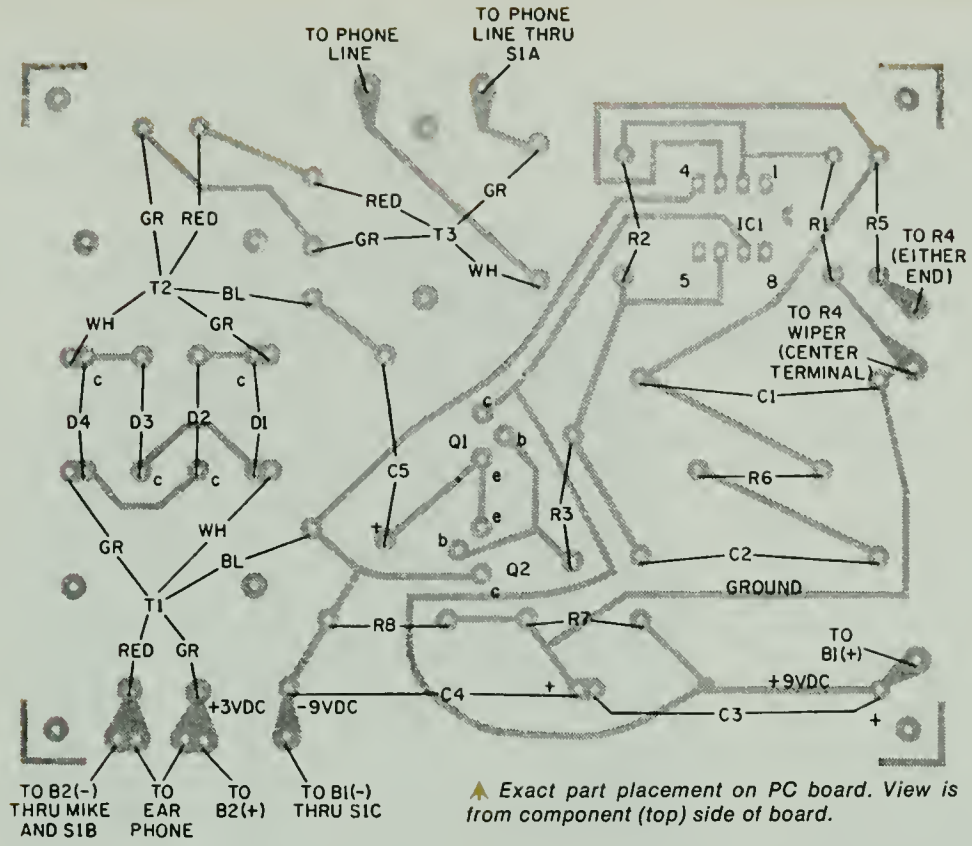


PARTS LIST	
B1	9-volt battery, Eveready 216 or equivalent
B2	3-volt battery, two AA penlight cells in series
C1, C2	0.01 μF polystyrene capacitor, 100 VDC or better
C3, C4	47 μF electrolytic capacitor, 25 VDC or better
C5	4.7 μF electrolytic capacitor, 25 VDC or better
C6	2 μF paper or mylar capacitor, 50 VDC or better
D1 to D4	Diode, IN914, HEP-156
IC1	Integrated circuit, Signetics N5741K or equivalent
Q1	NPN transistor, 2N2924, HEP-724
Q2	PNP transistor, 2N3638, HEP-716
R1, R3, R7, R8	1000-ohm, 1/2-watt resistor
R2	2,200-ohm, 1/2-watt resistor
R4	1000-ohm potentiometer
R5, R6	4,700-ohm, 1/2-watt resistor
R9	Limit line current to 25mA (see text)
S1A, S1B, S1C	Phone hook switch (see text)
T1 to T3	Small transistor audio transformer; 8-ohm primary, 1,200-ohm center taped secondary
Misc.	Surplus telephone, battery holders, hardware, knob, wire, solder, etc.

How it works. IC-1 and the associated circuitry form a stable audio tone generator which feeds a buffer amplifier, Q1 and Q2. The tone output is taken from the emitters of the transistor pair to supply a carrier voltage for a balanced modulator made up of four diodes—D1 through D4—and T1 and T2. If the two transformers and the four diodes are perfectly matched (which is almost impossible to achieve and not necessary in any case) no carrier will appear at the input or output of T1 or T2. In a practical circuit, a small amount of unbalance will occur and produce a low-level carrier tone at the input and output of the balanced modulator. This tells you your scramble phone is working.

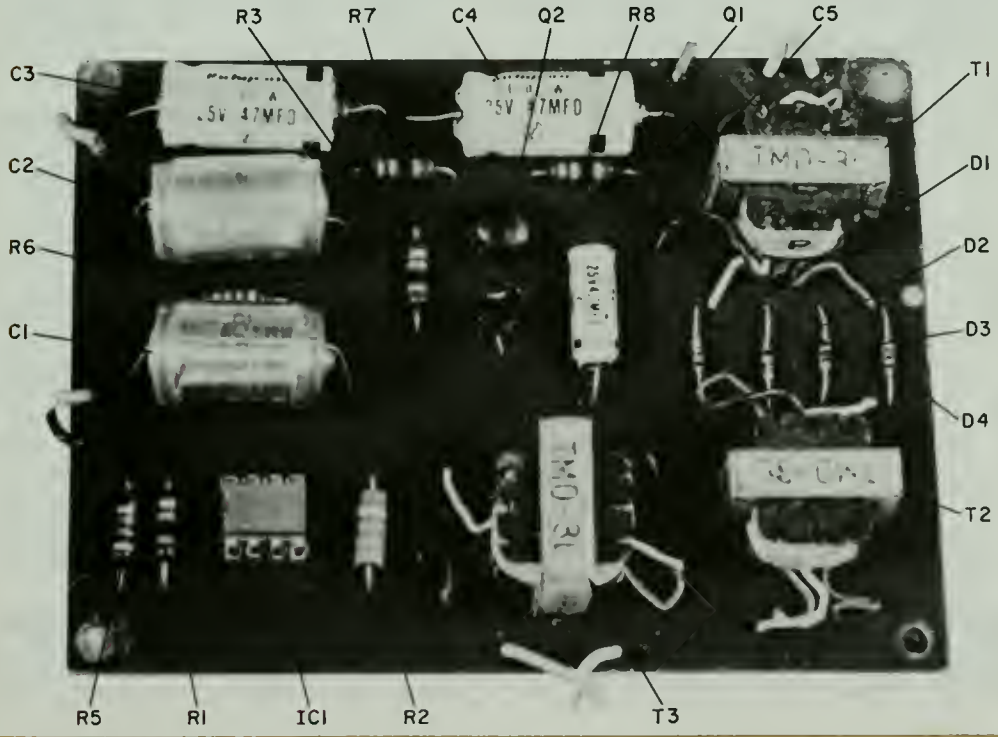
A telephone carbon mike and ear piece are connected to the low impedance winding of T1, with a 3-volt battery supplying the necessary mike current. When the mike is spoken into, the carrier voltage is allowed to pass, in part, through transformers T2 and T3, and on to the telephone network. The only purpose of T3 is to match the impedance offered by most telephone lines.

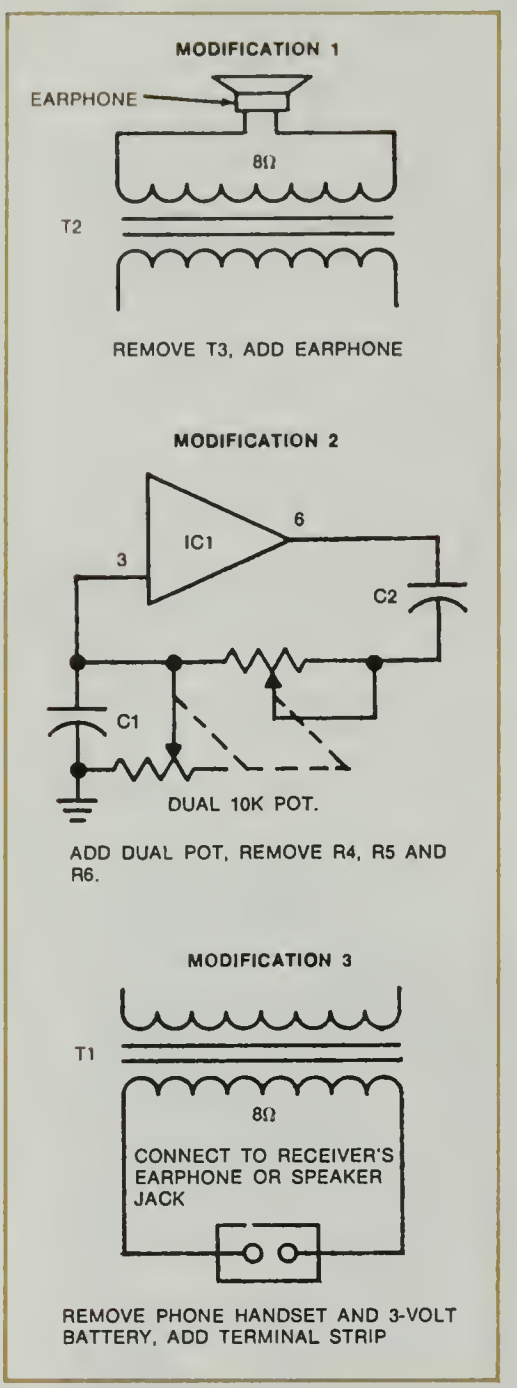
Trim potentiometer R4 is used to make a fine frequency adjustment of the oscillator so that two scrambler units may be synchronized to the same carrier frequency. Both



▲ *Exact part placement on PC board. View is from component (top) side of board.*

▼ *Layout shows a completed scrambler board.*





It is possibe to decode some older scrambler systems heard on 2-way radio bands. However, this single inversion mode circuit will not work with multi-inversion systems also in use.

oscillators must be operating at the same frequency to produce the best decoded speech quality. This control is referred to as the speech clarity control.

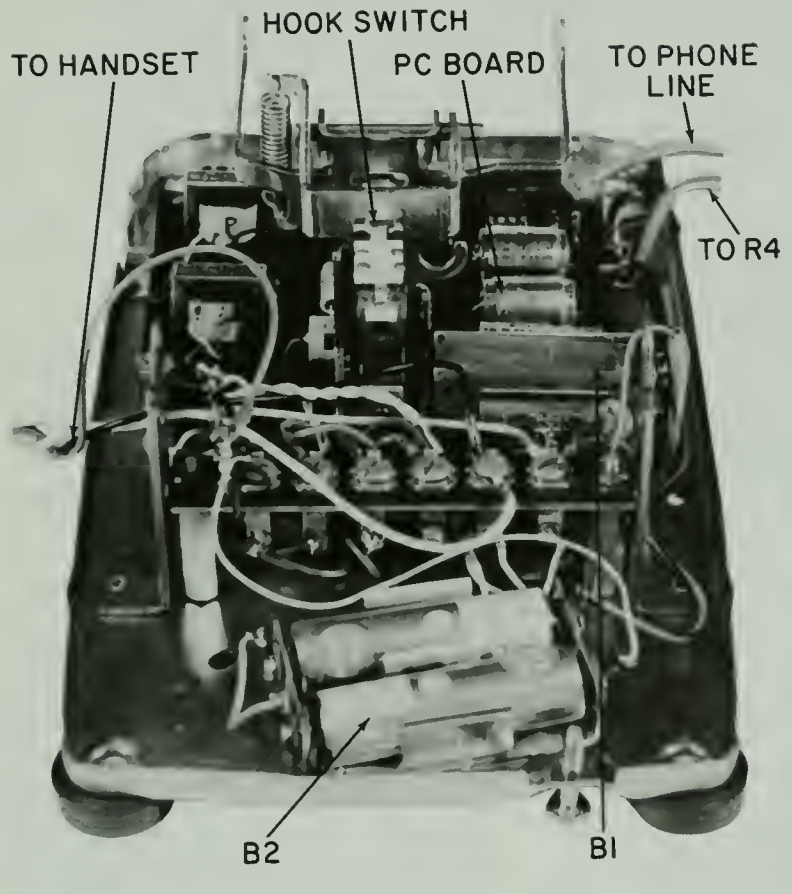
The best overall carrier frequency range to use for speech scrambling is between 2 kHz and 3.5 kHz.

Listening in. If the scramble phone is to be used for only receiver speech decoding, then only one unit is required. The operation is much the same as for telephone encoder/decoder purposes, with the exception that it is used only as a decoder. The carrier oscillator is made variable so the decoder may be synchronized to the same carrier frequency as is used in the encoder. The output of the receiver is connected to the 8-ohm winding of T2 (T3 is not required for this use) and the decoded information is developed across the 8-ohm winding of T1. A small speaker may be connected across this winding, or a low impedance earphone will do for monitoring the decoded speech. No mike or 3-volt battery is necessary for decoding operations.

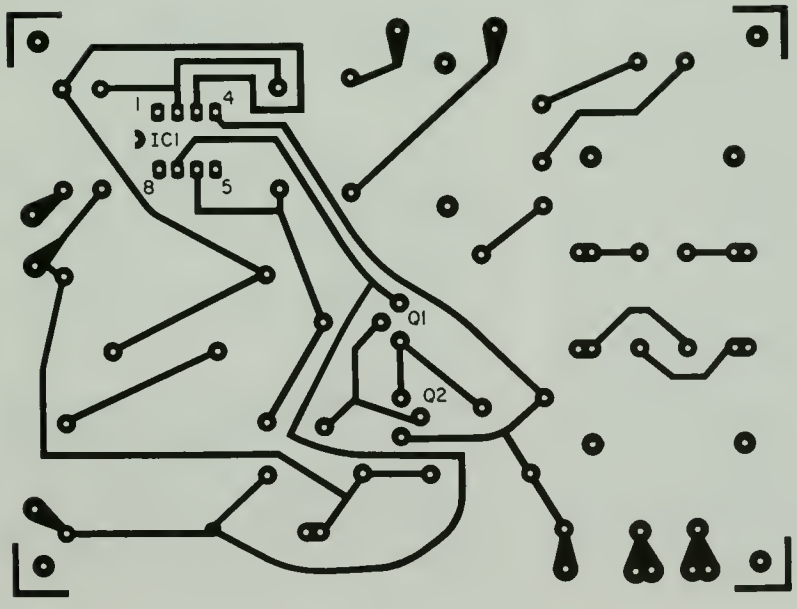
Putting it together. The circuit layout isn't critical and any suitable scheme can be followed, but the layout shown for the PC board would be a good one to use. No matter what construction plan is used, PC board or bread board, extra care should be taken when connecting the IC, diodes, and transistors to the circuit. Care should also be taken when connecting the three transformers, so that the low and high impedance windings are not reversed.

The size of the PC board allows the scrambler to be mounted in the base of a standard telephone. All parts located inside the phone, with the exception of the hook switch, can be removed to make the construction job an easy one. Check the pictures when mounting the board and batteries.

In some telephones, the hook switch contains enough switch contacts to function as the three switches, S1A, S1B, and S1C; but



Inside completed scramble phone. Surplus phones are available from a number of mail order firms as well as their local stores.



Exact PC board size. Transfer image to copper clad board using a piece of carbon paper. This is the bottom (copper) side of board.

if you have one that does not contain enough contacts, a separate switch must be added to switch the battery power. For the scramble phone to automatically bridge the telephone line when the handset is off-hook, at least one section of the hook switch must be used for S1A.

If a dial telephone is selected, the dial may easily be removed and replaced with a metal or plastic plate. The clarity potentiometer can be mounted at any convenient location on the phone's base plate, but be very careful not to let any component interfere with the operation of the hook switch.

Scrambling a phone. Connect the two scramble phones together (phone line outputs connected to each other) but separated by at least twenty feet. Lift either of the hand sets and you should hear a low level tone; talk into the mike and you should hear your own unscrambled voice in the ear piece. This reception of your own voice is normal and occurs when using a standard telephone; it is called the sidetone.

Have a friend or another member of your family talk over the scramble phone. If your reception isn't clear or sounds like Donald Duck, adjust the clarity control for the best voice quality. This simply puts the two oscillators on the same frequency.

Scrambler hook-up. This job is a simple one. All that's required is to parallel the output of transformer T3 with the telephone lines. But before doing so, make the following tests. If you are in doubt about which two wires on the telephone terminal block are the telephone circuit, take a DC volt meter and check between pairs until 24 to 48 volts is measured. This test must be performed with the telephone on hook. The second important check to make before connecting the scrambler phone determines the line current. This test is made as follows. Set the VOM to measure DC current on the 50 or 100mA range, and place the meter in series with a lead from the high (1.2 K) impedance winding of T3. Pick up the phone. If the circuit current is greater than 25mA, then the resistor/capacitor network C6 and R9 must be added in series with the scrambler phone and the telephone circuit. This should reduce the circuit current to a value close to 25mA, but if not, adjust the value of R9 (start with a 1000-ohm, ½-watt resistor) until this current value is reached.

Security link-up. After connecting one of the scrambler phones at your location and another at the home of a friend, dial his number with your standard telephone. When the party answers and agrees to go to the scrambler mode, pick up your scramble phone, and have your friend do the same. You can now continue your conversation in complete secrecy. If either of the scrambler oscillators should drift in frequency, just set the clarity pot for the best voice quality.

Scrambled signal decoding. If you desire to use the scrambler for receiver speech decoding only, then make the modifications shown. Basically, the resistors, R4, R5, and R6 are removed and replaced with a 10K dual pot to allow the IC oscillator to be tuned over a wide frequency range. Connect the input of T1 to the output of your radio receiver and a small speaker or earphone to the output of T2. Transformer T3 is not required for speech decoding; it can be removed.

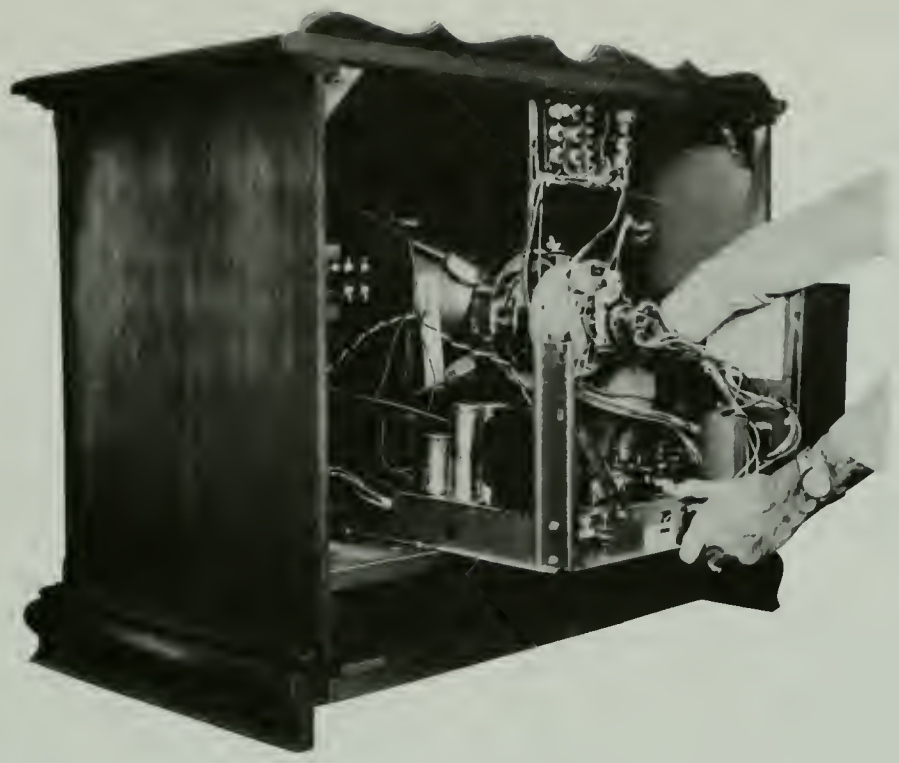
Tune the receiver to a station that is using the single inversion mode of speech scrambling, and adjust the oscillator's frequency slowly until the speech begins to sound normal. C.D.R.

See also: COMMUNICATIONS; ELECTRONICS; INTERCOMS; WALKIE-TALKIE.

WHERE TO FIND IT

For surplus telephones, see catalogs such as Lafayette, Radio Shack, EDI and BA.

Kits are available from Krystal Kits, Box 4232, Little Rock, Arkansas, 72204. Write to them for information.



Television Repair Tips

Even if you know nothing about TV sets, they should be easy to fix much of the time if you limit what you attempt to do and follow these repair hints

When it comes to do-it-yourself TV servicing, do you use the "shotgun" method to locate bad tubes? If you're the average, non-technical, television set owner you probably do, since you couldn't be expected to know exactly where the target is. What is meant by the "shotgun" method? Well, here's how it works:

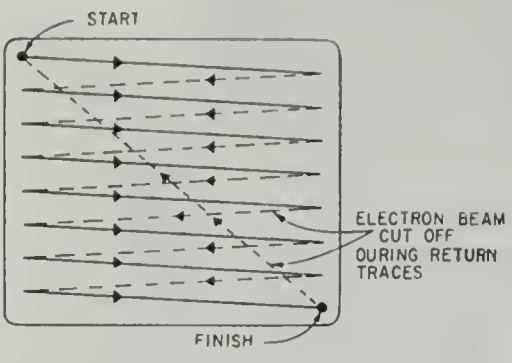
Your TV set is acting up. So you pull out all or most of the tubes, cart them down to the corner drug store or supermarket, and run them through the do-it-yourself tube checker. You find two or three that show a "bad" or "questionable" reading, so you buy some new ones. When you get home and plug in the new tubes, you may find that you still haven't cured the sickness. Even if you have, there's a good chance you've replaced some tubes needlessly, since a questionable tube-checker reading doesn't always indicate a bad tube.

What can you do to avoid this unnecessary expense? Here are some tips that may save you considerable cash and frustration the next time you tackle the one-eyed monster!

First, unless you have some technical knowledge of television, you shouldn't ordinarily attempt to carry servicing beyond the tube-changing point. You don't have to be an engineer or technician just to change a TV tube, but it does help to have a little familiarity with the inner workings of your set. This isn't as complicated as you might think.

Second, most TV receivers have, pasted

television service: see high fidelity systems
temperature detection: see home security sensors
tenoning jig: see jigs
tenons: see woodworking



▲ *Simplified diagram of TV raster does not show complicated interlacing.*

somewhere inside the cabinet, a tube location diagram. This gives you a wealth of information; it tells you the type and location of each tube, plus the kind of job it does.

Now, with these two pieces of knowledge at hand, you should be able to direct most of your trouble-shooting efforts to smaller sections of your set—to zero in on the exact tube or tubes ruining your viewing. You shouldn't have to use the expensive scatter-gun approach.

Before going any further, let's concern ourselves only with black-and-white TV. Unless you have considerable servicing know-how, it's best to leave most color TV repairs, even tube changing, to a competent repairman, since many of the circuits in color TV sets require critical adjustment for proper color rendition.

What is a television picture composed of? If you look at any newspaper photograph—called a "halftone" illustration—through a magnifying glass you will see that it is made up of rows of fine black dots. In the light areas of the picture the dots are very small, leaving considerable white space between. In the darker areas the black dots are larger, leaving less white space. At a distance your eye sees the whole mass as a complete picture, since it can't distinguish between the individual dots.

Now, turn on your TV set and tune it to some channel where no picture is being transmitted. Look closely at the screen. See how the picture is made up of a series of horizontal lines of light? These lines are actually traced on the screen by a rapidly moving spot of light produced when a sweeping electron beam inside the picture tube strikes the screen. The spot travels across the screen, starting at the upper left-hand corner and working down to the lower right-hand corner, as shown in the diagram. For the sake of clarity, the lines shown are much farther apart than they really are on your TV screen. There are actually over 400 of these lines on the screen.

When the spot gets to the lower right-hand corner, it returns almost instantly to the starting point and repeats the trace. This screen "painting" process is repeated at such a rapid rate that your eye cannot detect the movement of the spot, but sees the screen as though it were continuously lighted. The technical name for the lighted screen is the "raster." Keep this term in mind. It will be used again later.

Now, if you were to break up the horizontal lines into dots of varying brightness, you would have all of the necessary elements for a picture, as seen in the newspaper illustration. In practice, this is essentially what is done. The light and dark portions of a TV picture are produced by simply varying the intensity of the electron beam as it paints the screen. The signals that produce this variation originate in the camera in the TV studio. The image "seen" by the camera is swept by an electron beam in the same manner just described for the receiver picture tube. But instead of painting a scene, the camera breaks the image it sees into bits, like the dots in the newspaper illustration. These bits are sent out in sequence by the TV station, received by your TV set, and reassembled on the picture tube screen in exactly the same order and position. To create the illusion of a

complete picture, these bits are broken down and reassembled at an incredibly rapid rate, several million per second. Other signals transmitted by the TV station serve to synchronize the sweep of the electron beam that "paints" the picture in your tube with the sweep of the studio TV camera so that both will begin "painting" at exactly the same instant. The third signal transmitted by the station is the sound or "audio" signal. If the picture is in color, additional color-information signals are transmitted.

Now, take a look into your TV set. Look at the simplified block diagram showing the electronic-tube circuits in a typical black-and-white television set. Trace the routing of signals through the diagram. As you do this, refer to the tube location diagram in your own set and see if you can find tubes whose functions are the same as, or similar to, those indicated on the diagram shown here. In some cases you'll notice that a single tube does several jobs, possibly in completely unrelated sections. This is because many tubes contain two or three sets of elements in one envelope, a space-saving trick.

Sound, picture, and synchronizing signals from the TV station arrive via your receiving antenna and are all processed in the RF amplifier, mixer, oscillator, and video IF amplifier tubes.

These signals continue on to the video detector and video amplifier tubes where they are further processed. The picture signal is extracted and applied to the picture tube where it controls the variations between dark and light on the screen.

The synchronizing signals are routed through the sync amplifier and sync separator tubes, then applied as locking signals to the vertical oscillator and horizontal oscillator tubes.

The sound signal is separated at this point and passed through the sound IF amplifiers, ratio detector, and audio amplifier or output tubes, then to the loudspeaker.

Another circuit is the AGC, or automatic gain control.

The purpose of the AGC tubes is to minimize fading or fluctuations in the picture contrast that may occur when the incoming TV signals vary in intensity. This often happens when an airplane is flying overhead.

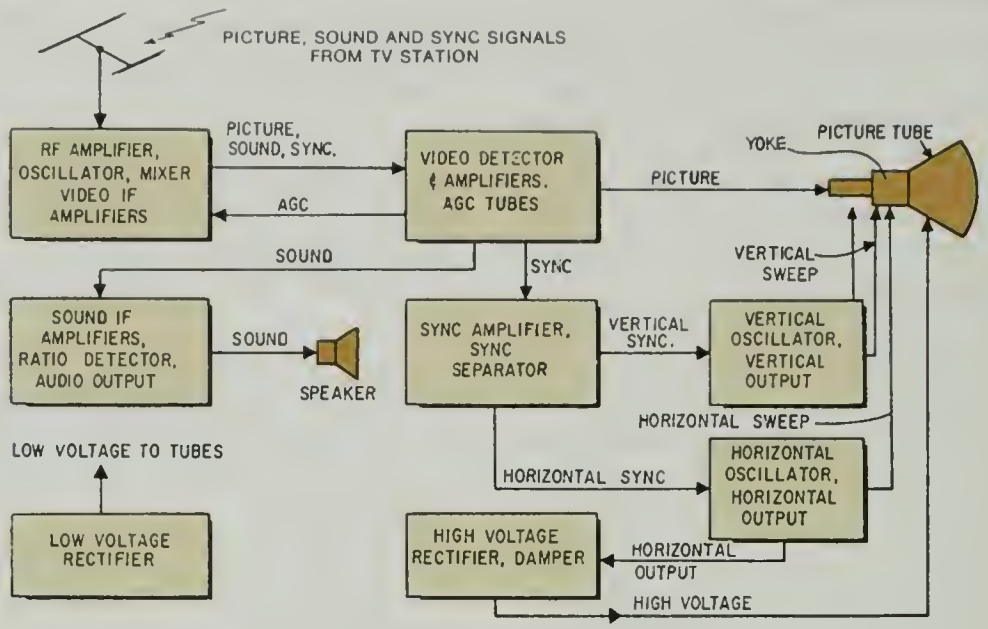
The vertical oscillator and vertical output tubes control the vertical sweeping of the electron beam in the picture tube. The horizontal sweeping of the beam is controlled by the horizontal oscillator and horizontal output tubes.

Every picture tube requires a potential of somewhere between 10,000 and 25,000 volts for its operation. This voltage is generated by the horizontal oscillator, horizontal output, high voltage rectifier, and horizontal damper tubes. Very little current is developed in most high-voltage systems, so it is generally not dangerous to human life; although if you get a jolt from it, it can be startling and uncomfortable—something like getting a shock from an automobile ignition system.

Finally, the low voltage rectifier tube supplies all of the lower voltages to the other tubes in your TV set. In the more recent models, a metallic rectifier is used instead of a tube for this purpose.

Now that you have more than a nodding acquaintance with your TV set, how can you use this newly gained knowledge? Here's an example, a typical troubleshooting situation:

Assume that your picture tube screen is brilliantly lighted and that the raster completely fills the screen. Yet there is no sound and no picture. Looking at our block diagram, you can see that the sections that are common to both picture and sound are the ones that include the RF amplifier, mixer, oscillator, video IF amplifiers, video detector, and video amplifier tubes. So you



Block diagram of TV circuitry is just about the same for all black and white TV sets.

proceed to check these tubes. Forget the others.

Another common TV complaint is vertical "rolling." The image keeps slipping up or down and cannot be stabilized by adjusting the vertical hold control. This symptom indicates that your TV set is not synchronized with the camera at the TV station. It is likely to be caused by a faulty vertical oscillator tube, or perhaps by a weak sync amplifier or sync separator. This narrows your search down to two or three tubes; no need to use the "shotgun" system. The trouble-shooting chart directs you to source of still more symptoms in a malfunctioning set.

The TV picture tube generally gives long life if properly installed and adjusted. Loss of electron emission due to old age is a common problem, however, and is indicated by a gradual dimming of the picture that cannot be restored by adjusting the brightness control or by replacing small tubes. The life of a picture tube that shows aging can often be extended by installing a picture tube brightener. However, you should not use a brightener on a perfectly good picture tube, since it increases the heater voltage and may reduce the life of the tube or even burn it out.

If you are going to use a picture tube brightener, first determine if your TV set has series or parallel connected tubes; then buy the corresponding type of brightener. If all of the tubes in your set (except the high voltage rectifier and picture tube) begin with the number 6 or 12, the tubes are probably parallel connected. If the tube designations start with various numbers other than 6 or 12, series connection is most probable.

Here are a few tips to keep in mind when replacing the small tubes in your TV set.

1. Be sure to turn off the receiver and disconnect the power plug before working inside the cabinet.
2. Wait for the tubes to cool enough to handle before trying to pull them out.

3. Discharge the stored high voltage from the picture tube by connecting one end of a well-insulated wire to the TV set chassis and touching the other end of the wire to the high-voltage terminal which connects to the side of the picture tube envelope. You'll probably have to slip the wire under the edge of the rubber insulator to make contact with the high-voltage terminal.
4. When you replace a tube, be sure that the new one is the correct type number as marked on the tube location diagram. Don't switch tubes around just because they look alike, unless they have the same number.
5. Be careful not to bend the pins on miniature tubes. Be sure the pins are straight before attempting to insert tubes in sockets.
6. If you doubt some of the readings you get on a do-it-yourself tube tester, recheck the tubes on another machine before investing in a new tube.

If your diagnosis fails to turn up a faulty tube because the trouble lies deeper, then you'd better turn the job over to your serviceman. However, if you're successful, you can sit back and bask in the glow of your TV set and the cash savings you've made!

R.F.L.

See also: ANTENNAS; COLOR TELEVISION; ELECTRONICS; HIGH FIDELITY SYSTEMS.

TV TROUBLE-SHOOTING CHART

Problem	Possible Cause
No picture, sound or raster.	Low-voltage rectifier. Filament burned out in one tube of series-connected string. Fuse.
Picture dim, does not fill screen. Sound weak.	Low-voltage rectifier.
Picture and sound weak or dead. Raster OK.	RF amplifier, oscillator, mixer, video IF amplifier, video amplifier.
Picture dead or has low contrast. Raster OK. Sound may be dead in some sets.	Video amplifier.
No sound. Picture OK.	Sound IF amplifiers, ratio detector, audio amplifiers.
Picture does not fill screen vertically. Cannot be corrected with height control.	Vertical oscillator and vertical output, low-voltage rectifier.
Picture rolls vertically. Cannot be stabilized with vertical hold control.	Vertical oscillator, sync separator, sync amplifier.
Picture does not fill screen horizontally. May also be dim.	Horizontal oscillator, horizontal output, damper, low-voltage rectifier.
Picture flops over sideways and rolls vertically.	Sync separator, sync amplifier.
Picture flops over sideways. Cannot be stabilized with horizontal hold control.	Horizontal oscillator, sync separator, sync amplifier.
Picture dim but raster fills screen. Sound OK. Sync OK. Cannot be brightened with brightness control. Image sometimes "blooms" around edges when brightness control is turned up.	High voltage rectifier, damper, picture tube.
Picture does not fill screen either horizontally or vertically.	Low-voltage rectifier.
Picture contrast fades up and down, excessively.	AGC, RF and IF amplifier tubes.

Getting the Most from Your TV

Anybody can make the adjustments needed to bring a TV set up to maximum performance and prolong its useful life—without spending a dime or replacing a part

TELEVISION SETS HAVE CONTROLS for good reasons. Knobs in front let you adjust the image until it agrees with your idea of a good picture. Further back are non-operating controls that need occasional touch-up. They'll shore up sagging tubes or aging components that can warp and shrink the picture.

Adjust controls and you'll delay the day the set needs tube replacement, maybe chassis repair. Best of all, controls keep the picture a pleasure to view, even on old sets.

You may argue that adjusting front controls is a matter of personal taste. True, but consider tricks that might improve your dialing technique—and reception. For though the main channel selector is nearly foolproof, other controls aren't so precise. Here's why.

Fine-tuning. Anyone knows this one is turned for best picture and sound. Trouble is that best settings for sound and picture often don't agree, especially in weaker signal areas. Fine-tuning must be a compromise. And the quickest way to find the best point is hunting for what's affectionately called "worms in the picture." Play around with the fine-tuning control and you'll see that turning it in one direction causes the picture to slowly fade. But turn it in the opposite direction and the screen should break into a mass of wriggles. Best adjustment of fine-tuning occurs if you back off slightly until the worms just disappear.

The slithery pattern is actually the sound carrier spilling into the picture. Use the tuning technique just described, and you can perfectly balance sound and picture as intended by the circuit designer. This method lets you capture good picture detail in the shortest possible time.

Vertical hold. If the picture's not rolling, some say, that's proof the vertical hold control is properly adjusted. But even if the image seems stable, the control may not be perfectly adjusted. TV pictures operate on interlaced scanning. It means the picture beam swings down and illuminates the screen on every other line (1, 3, 5, etc.). Then it repeats the scan for the missing (2, 4, 6) lines. This is a crafty trick to reduce flicker in the picture. But to do the job well, the set's vertical oscillator must perfectly

➤ *Even if picture isn't rolling as shown, vertical hold control may not be set properly.*

➤ *Setting brightness control too high will cause picture detail to wash out.*

➤ *Excessive contrast results in loss of picture detail and subtler gray shadings.*

Snowy picture with excessive contrast causes poor detail in image.

Horizontal hold should be set so picture is stable after channel is changed.

lock to the station's sync signals. And that's where tuning technique can make or break it.

If you adjust the control carelessly the picture may stand still—but the sync signal may have to work hard to keep it there. The result could be "jitter" or "pairing." Fine scanning lines on the screen bounce or run together, which, of course, steals sharpness from the image. You can avoid it by setting the vertical hold with this simple technique.

Turn the control until the picture starts rolling in a downward direction. Next, turn the knob slowly the opposite way until the image moves upward. Soon the frames begin to snap into place. When the picture's finally locked in, remove your hand from the knob. Always stop tuning on an upward roll of the picture. A close look at the screen should reveal well-separated, motionless scanning lines.

Horizontal hold. There's much leeway in this adjustment, since TV horizontal cir-

cuits are semiautomatic. A grossly misadjusted control will produce slashing diagonal bars. As the knob approaches correct setting, the number of bars diminishes until the picture stands up straight. Yet there is margin for error.

First, be sure the setting is stable, quickly checked by flipping among all receivable channels. There should be no loss of horizontal sync—even temporarily—each time the main channel selector lands on a new channel. Check the picture for any distortion or whitish areas, especially at the left. This control may be located at the rear in some sets.

Contrast and brightness. Little can be said about these controls since their effects are well known and settings mostly a matter of preference. Excessive brightness washes out the picture and may cause a few diagonal white lines to appear at the top of the screen. They're eliminated by slightly reducing brightness or increasing contrast. Pour on excessive contrast and the picture assumes a grainy texture of strong blacks and whites with loss of detail. Snowy reception is usually aggravated by too much contrast.

On some sets, excessive contrast might cause "sync clipping," which could cause a wavy unstable image. If it happens when contrast is weak, chances are the set needs a tube or repair in the IF or front-end stages. The range of contrast is often determined by the set's AGC (automatic gain control) circuit. If one is provided in your set, check its adjustment, as described later.

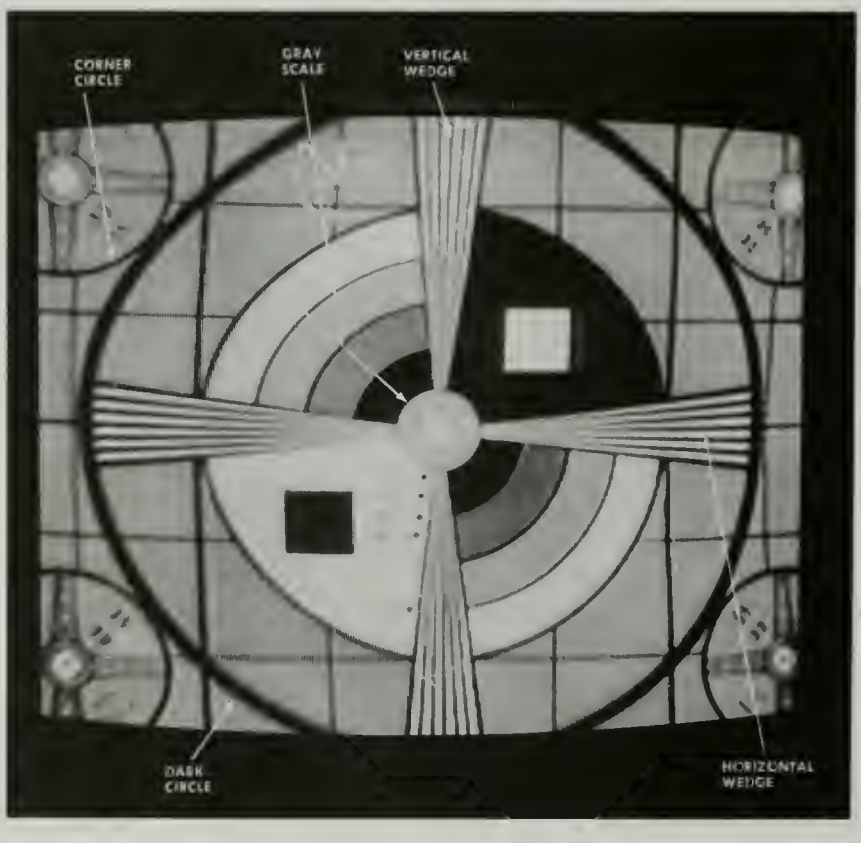
That takes care of up-front, user-operated controls that let you trim picture and sound for daily viewing. For the next group of adjustments—non-operating controls that need only occasional attention—you'll have to penetrate more deeply into the set. Some are accessible through holes; others require removal of the back cover.

If you can't locate a certain control there are several possibilities. One is that the manufacturer has completely omitted it (the horizontal width control is a casualty in some sets). Two, the control may not be readily apparent. An example is focus. Many sets eliminate a control and use ad-

Many late-model sets have horizontal hold control located on the back of cabinet.

Back of the set may have to be removed for access to little-used controls.

Test pattern transmitted by most TV stations before and after regular programming is invaluable for adjusting set's controls. Important elements are labeled.



One type of focusing arrangement is adjusted simply with a screwdriver.

justable metal strips on the picture-tube pins instead.

Since this and other controls may be difficult to find, you'll save time if you first obtain the service folder on your model. But before you touch anything inside the set, consider these precautions while you let the set warm up for 15 minutes.

High voltages required to operate the various parts of a television receiver present an extremely dangerous hazard. To protect the user from dangerous shocks, most TV sets have an interlock switch or special line cord attached to the back cover. When the back cover is removed, the interlock switch opens or the line cord is disconnected, opening the power supply circuit. A caution label containing this information is affixed to the back cover of most TV sets.

To gain access to such controls as the ion trap magnet, deflection yoke, and on many TV sets, the positioning and focus controls, you must remove the back cover. This means that you will either have to detach the line cord from the back cover, or use a separate line cord (cheater cord) to connect the set to the power outlet. On sets using an interlock switch, you will also have to secure the switch in the closed position, possibly with masking or friction tape.

In making adjustments you will be working in close quarters, relatively near parts having high-voltage. The following precautions should be observed when making adjustments inside the cabinet while the set is operating.

1. Do not adjust controls inside your set while standing on a concrete floor.
2. Make sure that there are no metal objects or wiring nearby through which you might make accidental contact to a good electrical ground.
3. Always keep one of your hands in your pocket when making your adjustments. This will prevent you from making a contact that could produce an unpleasant or dangerous shock.
4. Avoid contact with all parts having high-voltage, especially the picture tube anode, or, in the case of a metal shell, the tube.
5. In general, stay way from all tubes to avoid burns. A burn caused by a hot tube, or an electrical shock, can result in cuts or bruises from striking other parts as your hand is withdrawn from the source of danger.
6. Use only moderate pressure to adjust any of the controls on the neck of the picture tube. Undue pressure or a jar can break the glass envelope causing the picture tube to explode.

If you follow these safety rules and use sound and careful judgment, you can safely and correctly adjust your television set.

Test patterns. Many TV stations transmit a test pattern for short periods before

Improper setting of AGC control causes variety of symptoms like this.

Typical indication on screen when picture tube requires focusing adjustment.

and after their regularly scheduled programs. Test patterns are a valuable servicing aid in making rapid checks of the performance and adjustment of a TV receiver. If no test pattern is available at the time you adjust your set, you can use the actual picture to check the adjustment of the various controls.

A mirror placed in front of the set will enable you to observe the picture on the screen while you make adjustments from the rear of the set. Whenever the controls on any TV receiver are correctly adjusted, the test pattern should have the same general appearance as shown.

The elements of the test pattern are labeled in the illustration and should conform to the following specifications. The four small corner circles should appear just inside the corners of the mask when the horizontal and vertical size controls and the centering controls are properly adjusted. The dark circle is as round as you can get it when the horizontal and vertical linearity

➤ *Sets with sync stability control will require adjustment of this control when the condition in the photo is observed.*

➤ *Tilted picture occurs when yoke has rotated on picture tube neck, usually as a result of set being sharply jarred.*

controls are properly adjusted. Wedges are vertical and wedges are horizontal when the deflection yoke is properly positioned. The lines in the wedges are sharp and distinct when the focus control and ion trap magnet are properly adjusted. The concentric circles are of different shades from light gray to black, when the brightness, contrast, and AGC controls are properly adjusted.

AGC (automatic gain control). The AGC control, when properly adjusted, enables you to tune to different channels having various signal strengths without requiring you to readjust the contrast or volume controls each time you change channels. If the AGC control is improperly adjusted, a strong signal will cause the picture to have excessive contrast, and a hum will be heard in the audio. Often, the picture becomes completely distorted or it may even become completely negative.

To adjust the AGC control, tune the receiver to the strongest channel in the area and rotate the AGC control clockwise until

you notice excessive picture contrast, buzzing sound, and pulling or tearing at the top of the picture. Then rotate the AGC control counterclockwise until the picture becomes normal once more.

What AGC actually does is allow your set to work well under a variety of conditions. For example, AGC will tend to hold contrast at a constant level even though signal strength varies markedly. (Without AGC, you might be readjusting contrast for every channel you tune in.)

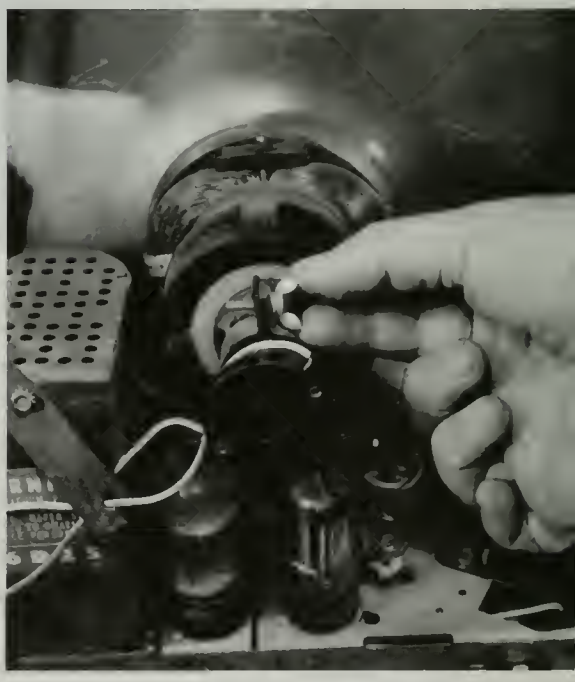
Focus control. There are three types of focus controls in use on TV sets. One type uses a magnet located on the neck of the picture tube. This can be adjusted by a shaft extending from the back of the set, or you may find it necessary to adjust several screws to correctly position the focusing magnet.

A second type of focus control uses a control to electromagnetically focus the beam.

A third type focusing arrangement uses a series of taps or terminal connections to which the focusing electrode is attached to give the best possible focus. An accompanying photograph shows the effect of an improperly adjusted focus control. Note the lack of definition in the image as compared with the normal test pattern. The focus control should be adjusted to give the sharpest, clearest picture possible.

Sync stability control. Improper adjustment of the sync stability control will result in bending of the image. This control adjusts a noise rejection circuit so that noise in the picture signal will not upset the sync. To properly adjust the sync stability control, observe the picture on the strongest local station with the AGC control properly set, and rotate the sync stability control counterclockwise until the picture bends at the top. Then back off the adjustment until the bending stops.

To adjust yoke, loosen clamp screw, hold only insulated part, and rotate carefully.



When yoke is positioned, tighten clamp screw, being careful not to over-tighten.

Untilled screen on either side indicates that horizontal centering controls generally are incorrectly set, though problem can also stem from electrical defects in the circuits.

Magnetic rings on picture tube neck behind yoke are used to center picture. The two tabs are rotated around neck for both correct horizontal and vertical centering.

Buzz control. Some late model, quality TV receivers, have a buzz control. This control is adjusted to the position at which hum, or buzz, in the sound is minimum.

Correct adjustment of the fine-tuning control, the AGC, and contrast controls also help eliminate buzz. These controls should be checked first for proper adjustment, then the buzz control should be adjusted for minimum buzz.

Ion trap magnet. To adjust the ion trap magnet, move it back and forth along the neck of the picture tube, rotating it slightly at the same time, until you obtain maximum brightness on the face of the picture tube. Next, adjust the focus and positioning controls (described below) and readjust the ion trap magnet. You may have to adjust the ion trap magnet so that the brightness is decreased slightly in order to improve the focus.

Many modern TV sets do not use an ion trap magnet. The phosphorous coating on the face of the picture tube is backed with a thin layer of aluminum. Electrons readily pass through this aluminum layer to strike the phosphor coated screen, but the heavier ions are blocked by the aluminum layer. The aluminum layer also reflects the light back to the viewing side of the screen that normally would radiate into the back of the picture tube. This type tube both dispenses with the ion trap magnet and will give a brighter picture than the type which does not have the aluminum layer.

Deflection yoke. The deflection yoke is located on the neck of the picture tube. Its purpose is to produce the varying magnetic field necessary to deflect the electron beam vertically and horizontally to produce the

➤ *If picture doesn't fill screen, yoke isn't properly seated against picture tube.*

➤ *Incorrect vertical centering in this photo is adjusted by moving magnetic rings on picture tube neck.*

scanning raster on the screen of the picture tube. If the yoke is not correctly positioned, a tilted picture will result. To correct a tilted picture, first make certain the yoke is positioned as far forward on the neck of the picture tube as the bell will allow, and then rotate the yoke until the picture is level. When the yoke is properly positioned, it should be secured in position by a clamp or lock screw. The picture doesn't fill the screen if the yoke isn't against bell or flared part of the picture tube.

Horizontal centering control. To center the picture horizontally, move the metal rings on the yoke cover until the picture assumes the desired position.

Vertical centering control. This control is accomplished in a similar manner to horizontal centering. Actually it is necessary to adjust for both vertical and horizontal centering at the same time.

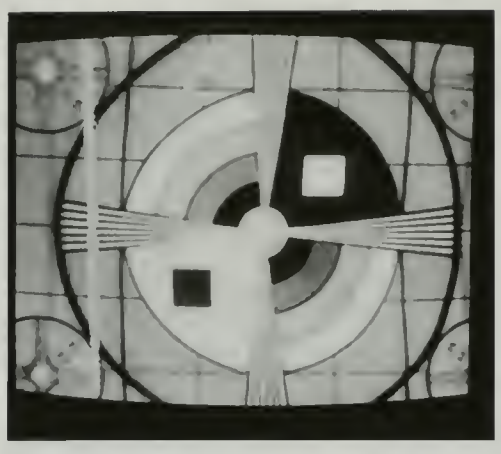
Horizontal linearity control. The horizontal linearity control may be adjusted to change the horizontal radius of the picture

➤ *This condition is corrected by adjustment of both the horizontal linearity control and the width or drive control.*

➤ *Picture with insufficient width to fill screen can be corrected by simply adjusting width control until picture is wide enough.*

from the center to the left or right side. A photo shows the effect of a misadjusted horizontal linearity control. Note the distorted left side of the picture compared with the right side. To adjust the horizontal linearity control, rotate the shaft until the horizontal radius of the picture from the center to the left side is equal to the radius from the center to the right side. It's often necessary to adjust the horizontal size control along with the horizontal linearity control.

Width (horizontal size and drive) control. In some instances there are two controls for adjusting the correct width of the picture. These are the width and horizontal drive controls. If the picture is too wide or too narrow, first adjust the width control until the picture approaches as near as possible the correct width. Then adjust the drive control until the picture fits the mask. If the drive control is incorrectly adjusted to give excessive drive, a vertical white line (overdrive line) will appear on the screen.



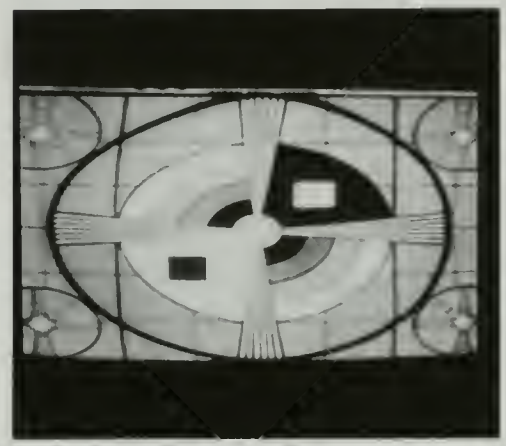
Too much horizontal drive causes vertical white line to appear on screen.

Height (or vertical size) control. A photo shows the effect on the picture of an incorrect adjustment of the vertical size or height control. In this illustration the picture is too narrow from top to bottom, but symmetrical with respect to the center.

Vertical linearity control. A photo shows a picture in which the vertical linearity control is misadjusted. In this case the picture is cramped from top to center. To adjust the vertical linearity control, rotate the shaft until the picture dimensions from top to center and from bottom to center are the same. To do this it is usually necessary to adjust the vertical linearity and vertical size controls alternately until the picture is linear and fits the screen.

If you've taken a half hour or so to make various adjustments, the set is warm enough for the next step. By retuning slugs in the TV tuner's local oscillator, you can shift the fine-tuning control so it centers on each channel. (This is not necessary on late models that have pre-set or "memory" fine tuning.)

Begin by pulling off both main and fine-tuning knobs (VHF only). This should reveal a small access hole in front of the tuner. Turn to your highest channel and set the fine-tuning shaft at the center of its rotation. Insert a non-metallic screwdriver into the access hole and tune the slug for best picture and sound, repeating this for every channel you receive. (Temporarily put back the main channel knob to flip to the next channel, but leave fine-tuning undisturbed.)



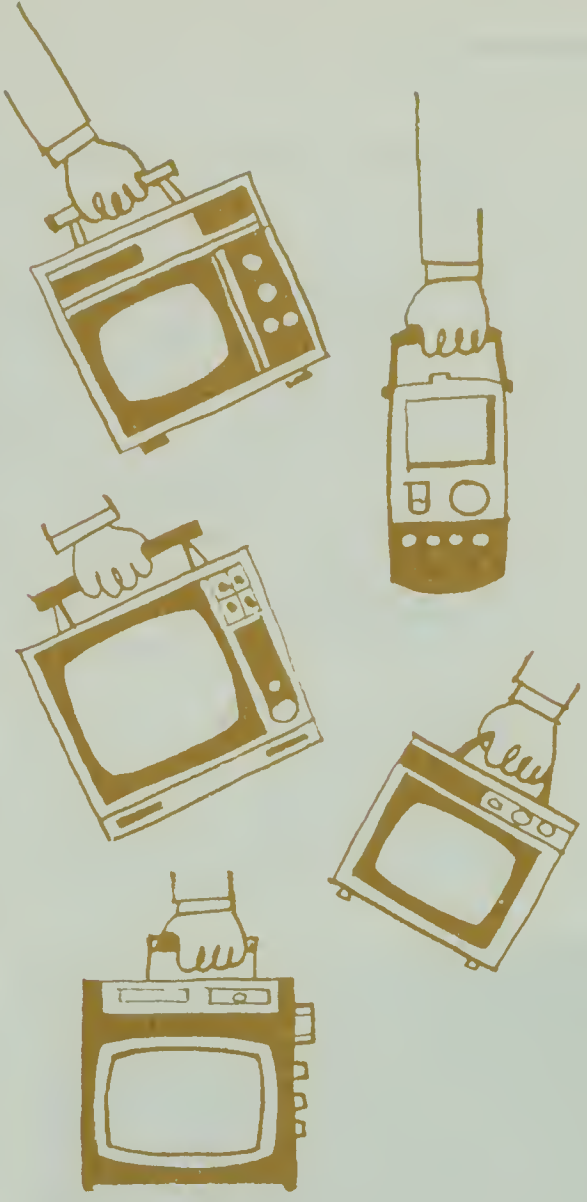
Flat-topped circle can be made round again by adjusting both the vertical linearity and the vertical height controls together.

Final tune-up consists of adjusting tuner slugs to center range of fine-tuning.

See also: ANTENNAS; COLOR TELEVISION; ELECTRONICS; HIGH FIDELITY SYSTEMS.

How to Service Portable TV Sets

You can fix these TV's yourself, although their compact design makes them somewhat more difficult to work on than standard sets



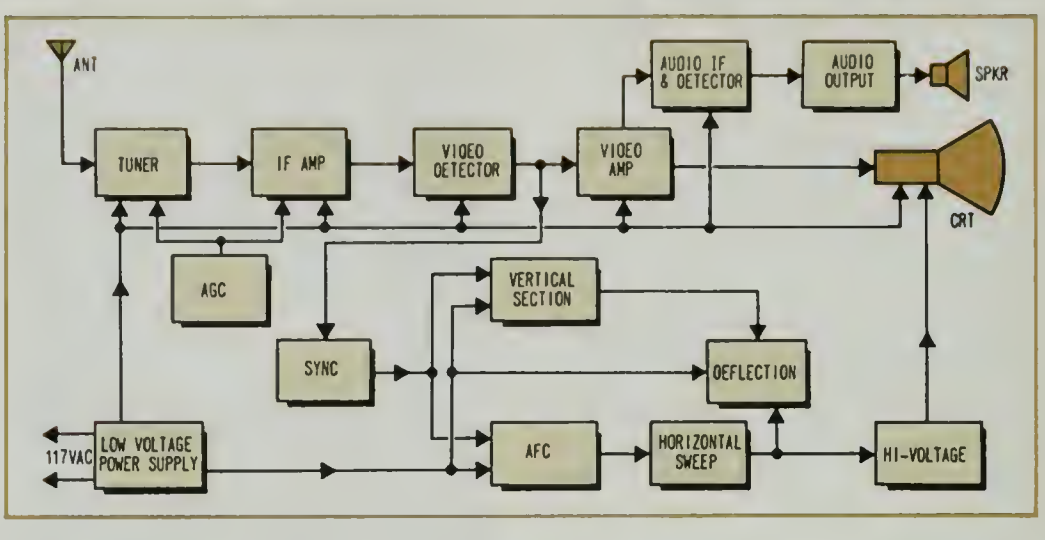
WHEN THAT PORTABLE TV is on the blink, you've got two choices: figure on spending a bundle having it fixed, or doing it yourself. Of course, doing it yourself can be a problem even if you've had experience with big brother console. That's because size considerations makes for design and construction differences. But take heart—the most common problems of a portable TV are often the easiest to repair. And with a few items of test gear and a little know-how you can tackle that misbehaving portable with confidence.

No picture or sound. This symptom is the easiest trouble of all to correct. Let's take a look at the block diagram. We see that practically every stage gets power from the low-voltage power supply. Let's begin right here.

Roll up your sleeves and pull the TV back cover off. First, see if the portable is an AC/DC or power-transformer type. The AC/DC portable TV receiver does not have a power transformer like the one shown in the photograph. All filaments in the AC/DC portable are hooked in series. In the power-transformer variety, the transformer supplies 6.3 VAC to all tubes in a parallel circuit.

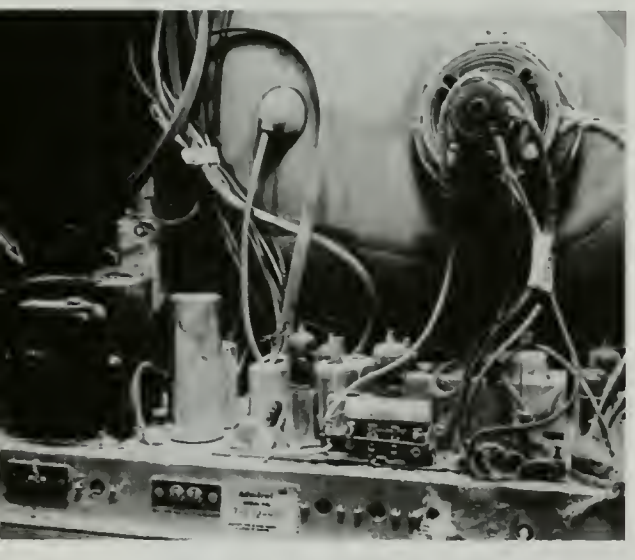
Now check the circuit breaker on the rear apron of the TV chassis. In most late-model sets, it's in the form of a small protruding red rod. Push this and the circuit breaker will reset. If this was the problem, the filaments should begin lighting. Often a tube in the sweep circuit, such as the damper tube, will arc over, kicking out the circuit breaker. If the tube starts arcing when the circuit breaker is reset, replace the tube.

Fused fuse. Take a look and see if all tubes light up. If they don't, check for a



▲ *Block diagram of standard TV set is useful when attempting to track down power supply troubles.*

▼ *Arrow points to power transformer in transformer type set. The absence of this or similar transformer indicates TV set is of the series string variety, which the majority of low-cost portables are.*



defective fuse. Some portable receivers have a circuit breaker and a low-ampere fuse in the AC line. Check the continuity of the fuse with an ohmmeter. Just looking at the fuse may not tell the tale. OK, the fuse is blown, so in goes another one. In some cases, only the type designed for the set will plug into the fuse holder.

Look at the schematic of your set and see if the fuse in the low-voltage power supply is like the hookup in the block diagram of the transformerless low-voltage power supply. Here is a 2-A fuse protecting the overload that may occur in the low-voltage power supply if associated circuitry suddenly shorts out

What makes the fuse blow in the low-voltage power supply? Check for a shorted selenium or silicon diode rectifier. Then go to the filter capacitors and check for other possible defective components that can be shorted causing an overload in the B+ line.

You can make a quick check of silicon diodes with the low-ohms scale of the VOM. Remove one end of the suspected diode, then place the ohmmeter leads across the diode rectifier. You should have a 5- to 15-ohm reading in one direction. Now reverse the ohmmeter leads. Does the ohmmeter still read 5 to 15 ohms? If so, the diode is shorted. A very high resistance reading should be noted with reversed ohmmeter leads. Very rarely do silicon diodes go open; they usually short out.

Smelly selenium. Selenium rectifiers will have a resistance reading from 20 to 25 ohms in one direction and over 3000 in the other. You can easily spot a defective selenium rectifier by its pungent smell. Also, black burned spots form on the selenium side of a defective rectifier of this type.

Let's say, for instance, the fuse is good but there's still no output voltage from the low-voltage supply. In this same circuit check to see if the 3-ohm resistor is open.

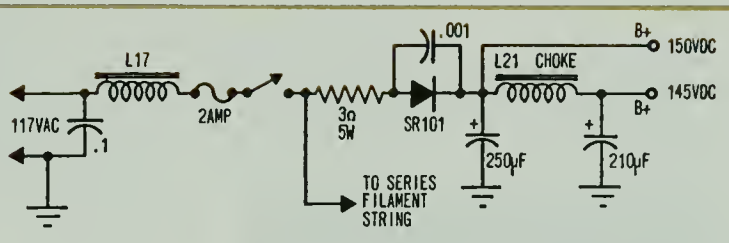
A voltage-doubler circuit used in series-string portable TVs (transformerless) is shown in the diagram. Here the fuse is a 0.4-amp type at the output of the power supply. After checking the fuse, go directly to plug-in resistor, R113 and see if it has burned open.

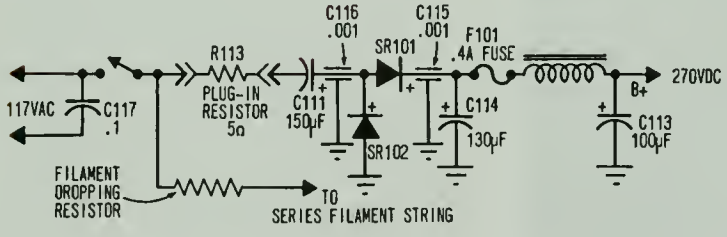
Now check the front-to-back resistance of SR101 and SR102, the two silicon diodes. Remember to always cut one lead loose for accurate measurement. If they're OK, then check the voltage-doubler capacitor, C111. These capacitors will dry out after several years of use. A white substance may have leaked out at the bottom of the filter, indicating the capacitor is defective.

To check the capacitor, shunt a new one across it. If that cures the problem, replace the defective capacitor.

Hum. If there's a hum in the sound, or dark bars across the screen, check the filter

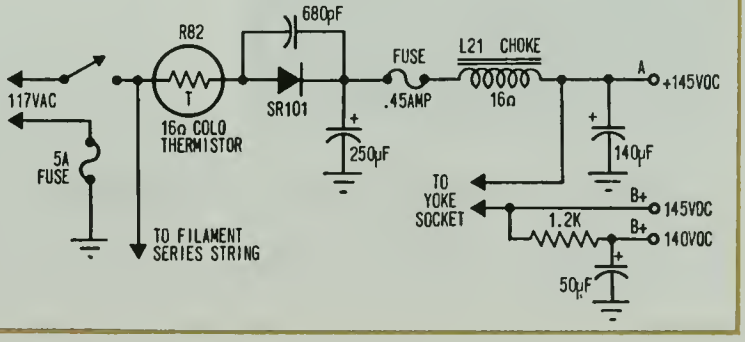
➤ *Schematic shows typical transformerless low-voltage power supply used in many portable TV models. Here, a 2-amp fuse is used to protect set from damage in case of short circuit developing in the B-plus line or associated parts.*

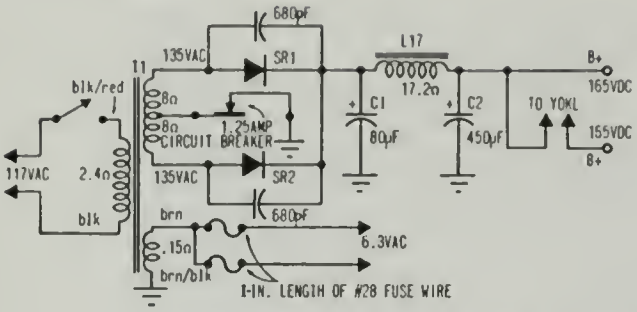




➤ *In this power supply circuit, the B-plus output is fused by F101 and the AC line protected by fusable resistor R113. This hookup is a voltage doubler, the output being twice the input rms value.*

➤ *In some sets, a thermistor is connected in series with the AC line to prevent voltage surges from damaging set when turned on. The thermistor protects set by having high initial resistance which then drops as thermistor warms up.*





Transformer power supply is used in better portable TVs. Typically, a circuit breeker is used in either AC line or in B-plus circuit, as shown here. Full-wave rectitication is provided by the use of two silicon diodes in this configuration, or in some cases, a bridge circuit employing four diodes. Typical DC-ohm values shown on transformer windings and choke lets them be easily tested with an ohmmeter.

Easiest way to check many tube filaments in a series-string TV is with simple continuity tester. What happens in this type of set is that when one filament burns out, none of the tubes will light up.

capacitor in your set equivalent to C113 and C114 in the diagram of the power supply with the fused B-plus output. Shunt a new capacitor of at least 450-VDC rating across the suspected filter capacitor and see if the hum disappears—if so, you've located the fault. When checking the power supply, always have the AC switch turned *off* while clipping the test capacitor across a suspect filter capacitor.

Another drawing shows a low-voltage power supply using a silicon diode as rectifier. Notice the thermistor resistor ahead of the diode. This resistor protects the series-string tubes by preventing surge voltage from being applied to cold tubes.

After several years' usage, the wires soldered to each side of the thermistor can pop off or come loose, leaving a high-resistance or open-current path. The results are intermittent or no output from the low-voltage power supply.

A low-voltage power supply circuit using a power transformer is shown in a diagram. The secondary winding is wired up for full-wave rectification with two silicon diodes in each leg. Notice the circuit breaker in the center leg of the transformer. In case heavy current drain in the B+ results because of defective components or a short circuit, the circuit breaker will kick out.

When this type of set is dead, check the B+ output supply voltage with a DC voltmeter. Also check the resistance of the two silicon diodes. Generally, when one is found

If a continuity tester isn't available, tube filaments can be checked with an ohmmeter. Listed is the approximate resistance value for tubes of various voltage ratings, e.g., 12BQ6 is 3—12.

TUBE HEATER RATINGS

Voltage (Volts)	3	6	12	17	25	35	50
Resistance (Ohms)	1-1½	2-5	3-12	5-12	10-20	30-50	50-60

If all tube filaments check out good, test the AC power switch with an AC voltmeter. If switch is good, no voltage should be indicated when on, 117 VAC should be indicated when off.

defective, both silicon diodes in that leg should be replaced. If the circuit breaker keeps kicking out after it's been reset a few seconds, short across the terminals with an alligator clip. Occasionally, the circuit breaker will become defective and will not hold under the ordinary power load and will have to be replaced.

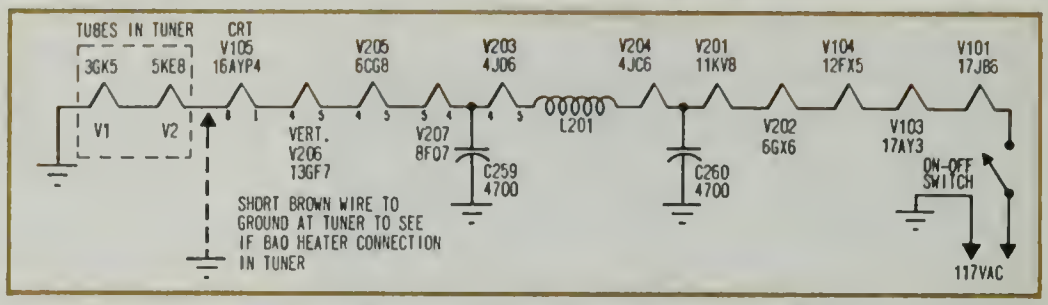
The second winding on the power transformer is the heater circuit. Tubes in transformer-type portable sets usually all operate on 6.3 VAC. This particular heater winding (hot side) has a 1-inch piece of #28 fuse wire so that in case of a filament or pilot lamp short circuit, the wire will open, protecting the transformer winding from overload. If the filaments don't light, check for an open fuse wire—if OK, check for an open transformer winding with an ohmmeter and one transformer lead disconnected.

When the tubes are dark in a series-string set, all tubes will have to be checked for an open filament because if one goes out, none will light. So with a tube filament checker or with an ohmmeter, check filament continuity.

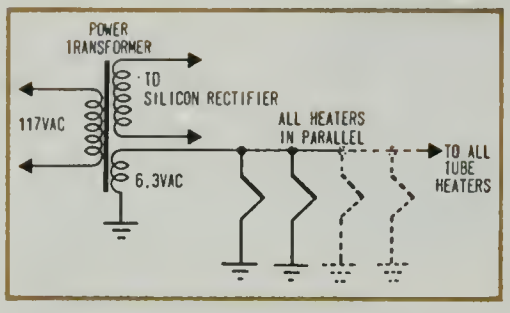
Continuity check. We know that one of these tubes, or possibly two, may have an open heater element. Take one tube out at a time and check it for continuity. Start with the horizontal output tube, damper, and sound output tube, in that order. These tubes run hot and are most likely to have a defective filament.

When checking filament continuity with an ohmmeter, switch to a low-ohm scale and place the probes across the heater terminals. The larger the heater voltage required by the tube, the greater the filament resistance measured should be. See accompanying filament resistance chart.

In case the problem hasn't been found after checking tube continuity, bring out the AC voltmeter. Switch the voltmeter to the 150-VAC scale. Place the voltmeter probes

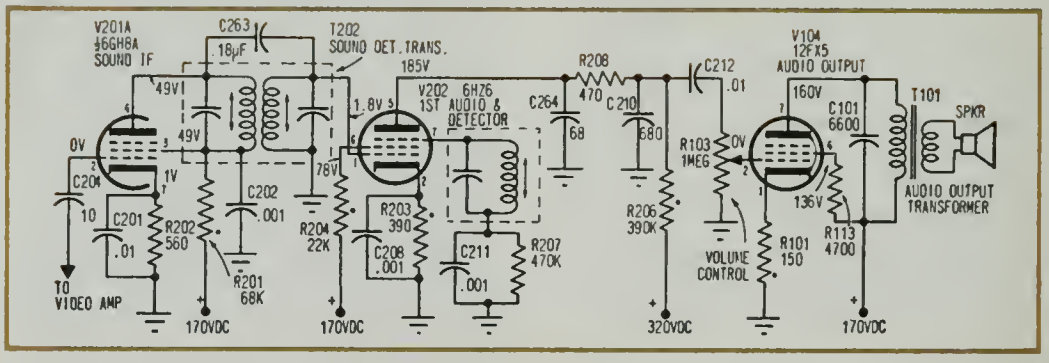


Typical series-string hookup can be quickly traced with AC voltmeter to locate break in circuit.



In transformer type set, one or two filaments may not light up indicating tube or associated heater wiring is defective. If no tubes light up in this type of set, check the power transformer, fuses in AC or filament line or circuit breaker, and AC switch.

The audio circuitry in your portable TV will look very much like this. If poor, distorted or weak sound is the problem, start by checking these tubes or their counterparts in your set. The next thing to check is the speaker.



across the *on/off* switch—it could be open. If this checks out OK, put one voltmeter lead to the *on/off* switch and trace the heater wires starting at the grounded side.

Most tuner tubes are located at the grounded side of the series filament string. Quickest way to eliminate a possible defective tube socket or broken heater wire in the tuner is to clip a shunt wire from the brown heater wire going from the tuner to the chassis ground. If the problem is in the tuner, the other series string of tubes will light up when the set is turned on. If so, you have isolated the heater trouble to the tuner section.

Remember that most portable receivers are of the series heater variety. When one tube goes out, the whole string is open like a string of Christmas tree lights.

A diagram shows a typical power trans-

former heater circuit with all tubes wired in parallel. In this type, one or two tubes may not light up indicating they are dead or their heater wiring defective. If all the tubes are dead in a power-transformer TV set, check for defective power transformer, broken heater wires, or open fuse wire.

When the picture tube has a raster, but there is no sound or picture, the trouble is probably in the tuner. The tuner is just behind the station selector knob. Substitute or check the RF and oscillator tube. If substituting tubes here doesn't produce picture or sound, check the IF and video output tube. Always replace these tubes if any element indicates shorted on a tube tester.

If the problem persists, try pulling the AGC (automatic gain control) tube out of its socket (with the set on) and see if the picture or sound returns for a split second. If so, your set has AGC troubles. A defective AGC tube can cut off both picture and sound. Another method for checking AGC is to turn to a weak TV station. The picture and sound may appear on a weak signal but can be blocked by AGC action on a strong TV station.

No picture—raster—good sound. When there is sound, a good raster, but no picture, the trouble is likely to be in the video circuits. Most portable TV sound circuits are connected to the beginning of the video circuit, so the problem will be somewhere after this point. Substituting or checking the video amplifier tubes will usually solve this problem.

The cause of excessive picture smear and tearing can usually be found in the video amp circuits. Open peaking coils in the video output circuit will result in a smeary picture. An open or leaky coupling capacitor from video amp to CRT can also cause picture smear.

Another possibility is a shorted picture tube. Simply tap near the end of the CRT, but gently, while watching the picture in a hand mirror. If the fault comes and goes while you're tapping, replacement of the CRT is the answer.

No sound—good picture. When everything is fine but the sound is missing, go directly to the sound amplifier section and check the sound tubes, starting with the output tube. A defect here can cause no sound, extreme distortion, or excessive hum. If a tube is not at fault, check the speaker and cable connections. Also check for a defective output transformer. This can easily be accomplished with an ohmmeter continuity check. Distorted sound can be caused by the cone resting on the center pole piece, in which case the speaker must be replaced. Small holes poked into the speaker cone can be repaired with glue.

Intermittent sound can be caused by a cracked PC board. Push and move the small parts on the PC board with an *insulated* tool while the set is on. Intermittent IF and detector coils may have cold solder connections inside the metal can.

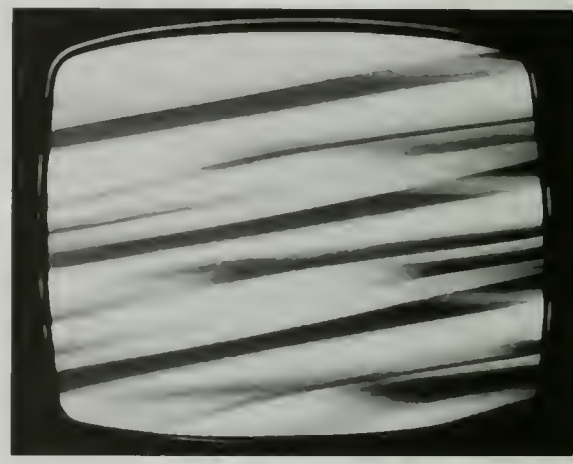
Black screen—good sound. Here we probably have a horizontal sweep problem (but be sure it is not just the brightness control turned all the way down). Be extremely careful when working in this section as LETHAL voltages exist. Keep the set turned *off* unless stated otherwise. The CRT capacitively stores up to a 20,000-volt charge so do not touch the high-voltage nipple—even with the set *off*. As a further precaution, keep one hand *behind* your back, away from the ground or chassis, working with the other. This will keep possible shock from being dangerous.

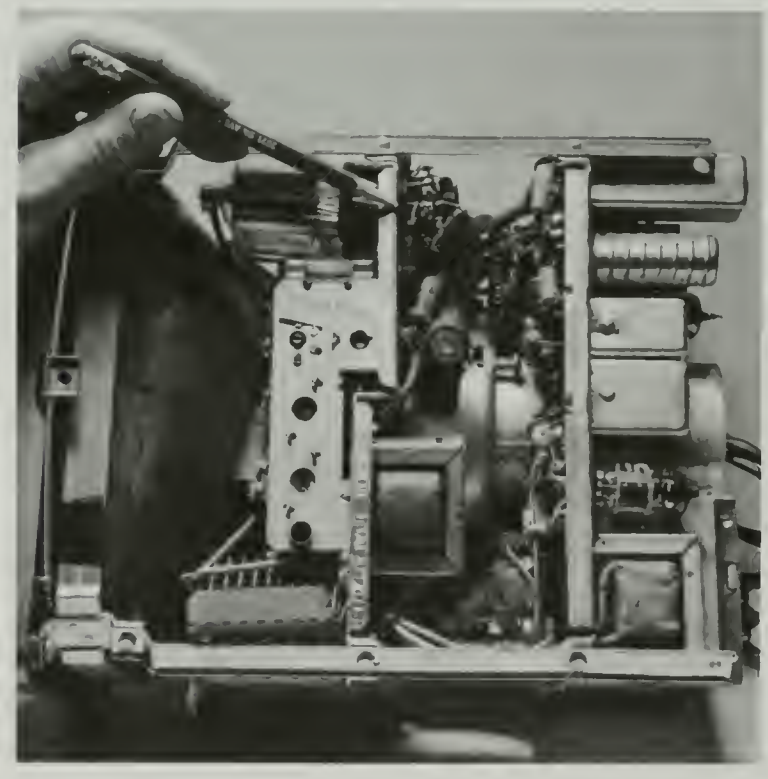
First off, check the horizontal output, damper, and horizontal oscillator tube, in that order, with the set *off*. Then check the high-voltage rectifier tube after shorting all exposed high-voltage cage connections to ground to assure everything is discharged.

Look closely for a burned spot on the flyback transformer indicating it is defective and may have to be replaced. Then take a small, *well-insulated* screwdriver blade,

▲ *Insufficient width is caused by the horizontal sweep voltage being low. This problem is most often traced to a weak or defective horizontal output or damper tube, but can also be low B-plus voltage.*

▼ *When the horizontal won't lock in, check the horizontal oscillator and output tubes. If all right, try adjusting the horizontal frequency coil slug, usually on rear skirt of set.*





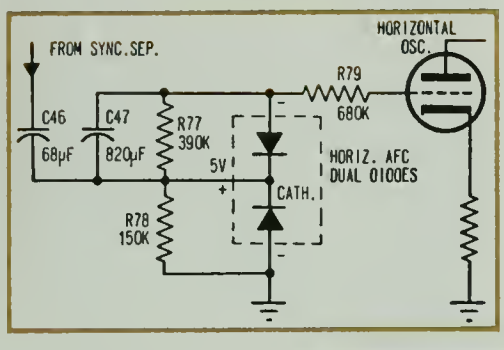
◀ *If tubes are not the cause of a narrow raster, circuit components associated with the horizontal and damper tubes are likely candidates. Pencil points to the horizontal output tube circuit.*

slip the blade under the horizontal output cap while the set is *on* and draw a small arc from the plate terminal. If no arc appears, there is probably insufficient drive voltage to the horizontal output tube. Take a voltage reading at the grid pin; it should be from −5 to −25 VDC.

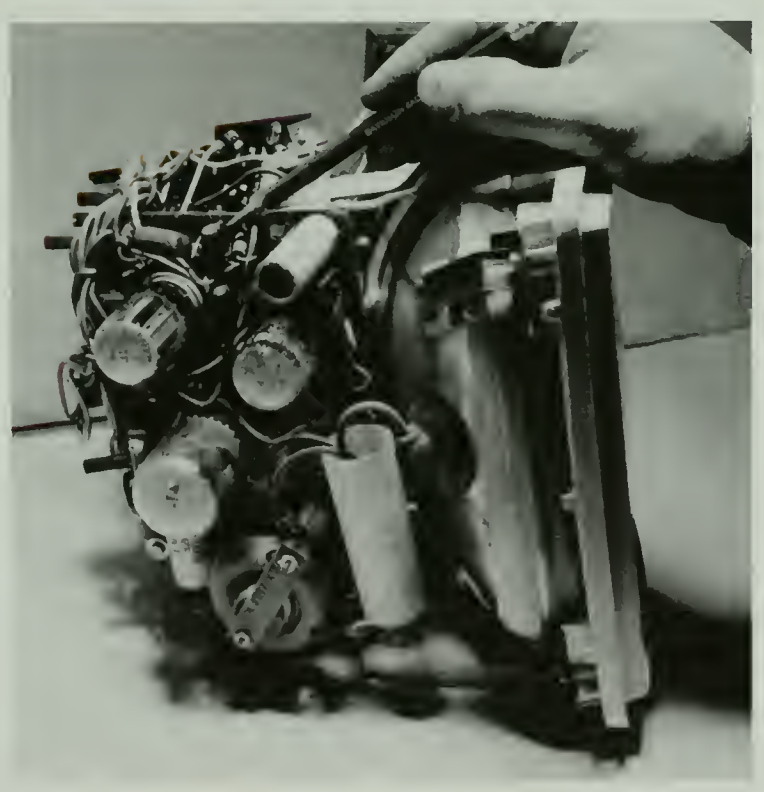
All of these checks can be made from the top of the chassis. Never measure the cap, or plate, voltage on a horizontal output tube. You can easily wrap the meter hand around the stop terminal. To measure the grid drive voltage, pull the plate cap off the horizontal output with the set *off* and then turn set *on*. If the voltage is normal, the horizontal oscillator section is performing. The trouble must be between the horizontal output tube to the CRT.

With the set off, *carefully* pull the cap off the high-voltage rectifier tube with a pair of insulated long-nose pliers. Turn the set *on*, let it warm up, and then arc the screwdriver blade to the terminal inside of the high-voltage cap. A good hot arc can be drawn up to half an inch long, if the horizontal sweep section is working properly. Turn the set *off* and replace the tube cap.

To see if the high-voltage is being applied to the CRT, short the high-voltage nipple on the CRT to chassis ground with a long, *well-insulated* screwdriver. Be extremely careful here. Placing the metal screwdriver to the ground and sliding it to the high-



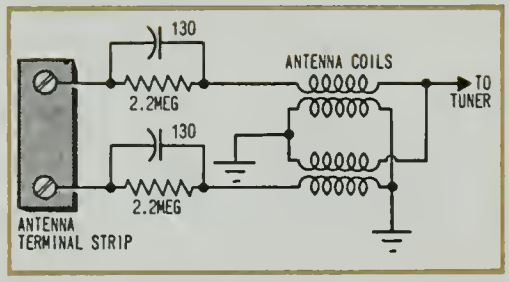
If horizontal still can't be locked in, the next thing to check is the AFC (automatic frequency control) diodes, usually in the form of a single common-cathode three-lead package.



The vertical oscillator circuit can also cause the absence of vertical sweep. The pencil points to the oscillator feedback coupling capacitor, one possible suspect; also check the vertical transformer.

A snowy picture with little contrast and weak detail is often caused by a weak RF amplifier tube in the tuner. This symptom can also mean a broken lead-in wire, shorted antenna, or open antenna coils.

The antenna coils are usually hooked up in this way. The capacitor/resistor network is designed to prevent lightning from damaging tuner. Check that capacitors, resistors and coils haven't been damaged.



voltage anode connection should produce a sharp high-voltage arc.

If not, shut down the TV. Short the picture tube high-voltage cap to chassis ground. Also discharge the CRT by using two large screwdrivers, one on the anode connection and the other to black CRT coating. Snap out the high-voltage cable and fire up the receiver. Arc the high-voltage cable to chassis and a sharp-high-voltage arc should occur. In case there is plenty of high-voltage, the picture tube is probably defective.

Sides pulled in. Insufficient horizontal width indicates insufficient high-voltage on the CRT. The trouble can be a weak horizontal output, damper, oscillator tube, or all three. Don't overlook the possibility of a weak low-voltage rectifier tube that supplies power to the horizontal sweep stages. Check the setting of the horizontal linearity or width coil.

The screen-grid resistor and bypass capacitor of the horizontal output tube are likely components to check if insufficient width is the trouble and the tubes are O.K. Check for low grid drive voltage on the output tube and check the associated components. Most width problems are found in the horizontal output sweep circuit.

Also look for a brass sleeve (on some portables) around the CRT gun and yoke assembly. Loosen up the yoke assembly screw and pull the brass shim out toward the picture tube socket to increase picture width. On deluxe portables with a horizontal drive control, check that it's set correctly. Try adjusting the control for correct width. Going too far will produce one or two white vertical drive lines from the middle to the left side of the CRT screen, in which case the control should be backed off a bit.

Horizontal lines. Check the horizontal tubes when lines are lying across the CRT and cannot be straightened up with the horizontal hold control. If this doesn't do the job, adjust the horizontal frequency coil slug. Set the horizontal hold control in the center of rotation and adjust the horizontal frequency coil slug until the picture locks in. Now switch the channel selector knob to another channel and see if the horizontal circuit stays locked in. If not, it may be necessary to make another fine adjustment of the horizontal frequency coil.

When the horizontal lines will not

straighten up or the raster goes into a "Christmas tree" effect or jagged horizontal lines, check for a defective AFC circuit. In current portables, a duo-diode rectifier with three leads serves as the AFC component.

To remove the duo-diode, cut off the leads about ½-inch from the PC board. Now you can solder a new AFC diode (or the old one) to these leads. Take a resistance measurement of the duo-diode rectifier; these are usually of the common cathode type (the center terminal is common to the two outside leads). Connect the ground lead from the ohmmeter to the center diode terminal. Now measure the resistance from each outside lead; the reading should be around 20 K. Reversing the ohmmeter leads should produce a zero-ohms reading. A leaky duo-diode will show a low resistance both ways.

A keystone, or triangular, picture is caused by a shorted deflection yoke and can only be remedied by replacing it with a new one. Bending and pulling of the picture can be caused by a defective horizontal oscillator or output tube. Excessive blooming of the picture when the brightness control is cranked up is caused by weak horizontal output or high-voltage tube.

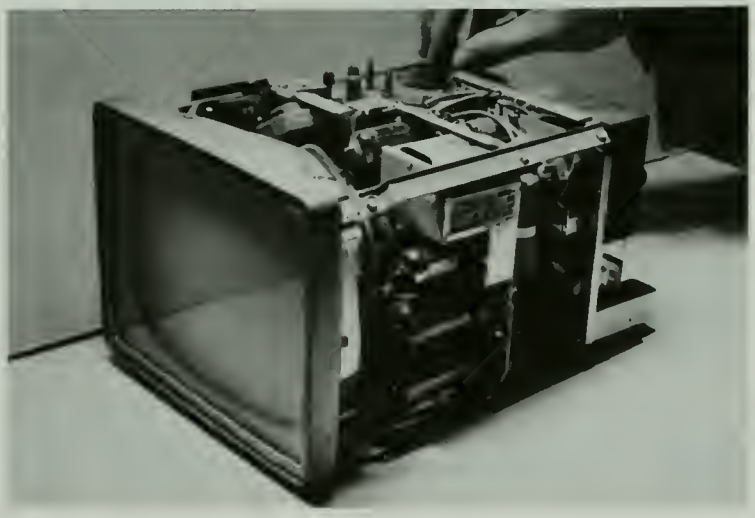
Bright horizontal line. If the picture consists of a single horizontal line, replace the vertical oscillator and multiplier tube. The bright horizontal line indicates the vertical sweep is not operating.

If tube replacement does not help, try adjusting the vertical height and linearity controls, or both. It is possible for the vertical height control to have a burnt spot, causing the vertical sweep to collapse. Check for continuity of the vertical output transformer windings. Also check to see if the feedback coupling capacitor shown in the photograph is leaky.

For insufficient height, at top or bottom of the raster, adjust the vertical height and linearity controls. A weak vertical oscillator or output tube can cause this problem, too.

Constant vertical rolling of the picture can often be cured with a new vertical oscillator tube. If the picture is unstable both vertically and horizontally, the fault lies in the sync section. Replace both vertical and sync separator tubes. Some portables have both features in one tube, while others may have these sections in a separate tube or located in one half of another dual-function tube.

Snowy picture. A picture very light in detail with a lot of snow on the screen is usually caused by a defective RF tube in the



➤ *If the picture jumps around every time you touch the channel selector, the tuner probably needs cleaning. Get a good spray lube and spray it on the contacts while briskly rotating the selector knob.*

tuner. Substitute a new RF, oscillator, and first IF tube and see if the situation improves.

Picture still snow? Then dig into the antenna coils and lead-in connections. Most portable receivers have isolating capacitors in the antenna input terminals. These capacitors protect the antenna coils and tuner.

In case lightning has struck your antenna, you may find one or both of these capacitors blown open. With an ohmmeter, check continuity of both antenna coils. You will find the antenna coils located on top at the rear, or inside, of the tuner cover. Be sure and replace damaged antenna coils with direct factory replacements.

Stations won't stay on channel. In case the picture will not stay on channel or becomes snowy when the channel selector is jogged, clean the tuner with a good tuner spray lube. With the strip or turret-type tuner, clean the contact points with rag and cleaning solution. Bear down with the clean section of the rag to brighten up the contacts. Apply contact grease over the clean contacts and spray the contact springs located under the tuner drum.

Many small tuners use a rotating multisection wafer switch. Spray these contacts and rotate the tuner shaft at the same time. Select a good tuner spray that won't be harmful to plastic parts in the tuner.

Conclusion. There are many troubles that can develop in a portable TV. Remember to go slow and easy. Look, listen, and try to isolate which section the trouble is in. Be careful not to break off any control knobs on the rear of the chassis or damage the set in any other way.

You will find that all tubes and parts are quite close together in portables. Some of the tubes and parts are hard to get at, so proceed with caution. If the set has been subjected to abuse, don't forget to check the PC board for possible intermittent condition. Especially on the earlier sets, PC boards were subject to many problems.

But with care and a little use of the old think tank, most portable TV problems can be easily solved. So go to it with confidence and save a few bucks while you're at it. H.L.D.

See also: ANTENNAS; COLOR TELEVISION; ELECTRONICS; HIGH FIDELITY SYSTEMS.

Attempts at reducing overall size of portable TV sets have resulted in very crowded chassis layouts. This makes the portable a great deal more difficult to work on and care must be used not to damage set.

How to Pitch a Tent

Doing this job well can mean the difference between a good night's sleep or a night spent fumbling in the rain and dark trying to correct the previous evening's mistakes

NO MATTER WHERE YOU CAMP, look hard for a good tent site. In many public campgrounds, you have little choice. The areas are so neatly and thoroughly planned that spaces for tents are practically predetermined. Even so, a camper should look to see that he is not erecting his tent beneath dead branches that might drop in a storm. And the farther back from the road you set your tent, the more dust-free your camp will be.

Here are some other points to keep in mind. In some areas, rock slides are a possibility and the tent, understandably, should be kept well out of reach of rolling stones. It should also be set on ground high enough to protect it against flash floods. This is especially important in parts of the West where creek beds are dry much of the year. A heavy rain may send a flash flood down the valley.

Check the tent floor area for rocks and sticks and remove them before spreading the canvas out. Otherwise, they may punch up through the tent floor.

Choose a level tent area or you may spend the night pulling yourself back up hill. Also, avoid locations where the tent is close to tall, isolated trees. In a storm, such "towers" sometimes attract lightning.

Give a thought to the prevailing winds. If the weather is extremely hot, you will probably want to face the tent's door or large windows toward the breeze. Otherwise, you may want to turn the tent away from the wind. In either case, make the decision before you set up.

Today's tents come in a wonderful variety of shapes, sizes colors and materials. Years ago you could list the kinds of tents fairly easily. There were wall tents, umbrella tents, pup tents, lean-to tents and explorer tents. As for color, they were usually a dirty grayish green. They might or might not have floors or screens, and the interior was a world of dark shadows. Times have changed. The old drab tents are rapidly disappearing—perhaps for all time. Today's variety—and you can see them by driving through any campground—offers all manner of geometric shapes. They may have inside poles, external poles, or seem to stand without obvious support. The variety is enough to make one wonder how many ways there are to pitch a tent.

The comforting fact is that there are

terrace: see brickwork
thermostatic air cleaner: see air cleaners
three-in-one wallbed unit: see beds
tic-tac-toe game board: see game boards
tile, bathroom: see bathrooms

First, assemble ribs of Prairie Schooner, stake down front or beck corners, unfold into position.

not as many tent pitching methods as styles of modern tents would indicate. In fact, most tents can be erected by following a few of the same basic principles employed when Model-T owners took vacations.

Assume that you are setting up an umbrella tent. Back yard practice sessions are the best ways to set up a new tent for the first time.

First, stretch out the tent floor and stake down the corners. The beckets, or cloth loops through which stakes fit around the bottom of the tents, are sometimes made too weak for the job asked of them. Some campers strengthen them with loops of rope.

After staking the floor down, the aluminum poles that are supplied with many tents can be assembled. The various umbrella and wall tents may have either internal or external frames. If they are made for the outside of the tent they are assembled and set in place, and then the tent is suspended from them. If they are internal frames, one person crawls into the tent and lifts it and fits the supporting frame into position. Any

Corners of external frame tents, like this model, are staked first, then frame is assembled over tent.

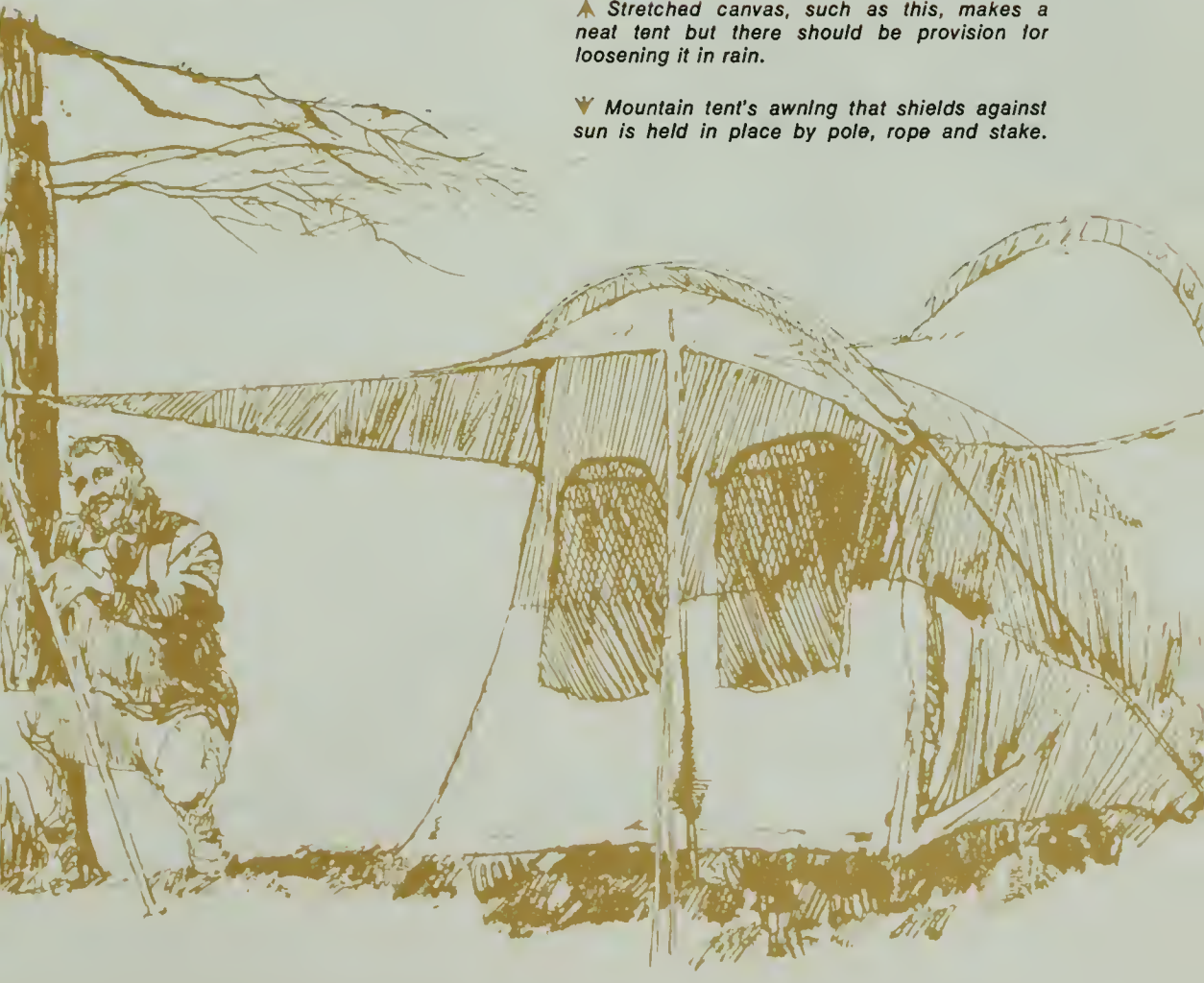
necessary additional guy ropes can be staked out to strengthen the tent.

The rule of staking down corners does not apply to pop tents and others which have built-in support. In these tents, the poles are so much a part of the tent that the whole structure, once pitched, can be picked up and moved from place to place. With their built-in fiberglass sectional supports, the stays, like ribs, are fitted together then the tent is opened up into its completed shape. Stakes are used more to protect against the wind's moving the whole tent, than against its falling down.

The real test of a camper comes when he must erect his shelter on inhospitable terrain. Sandy beaches may be wonderful places to swim and collect shells, but

Stretched canvas, such as this, makes a neat tent but there should be provision for loosening it in rain.

Mountain tent's awning that shields against sun is held in place by pole, rope and stake.



beaches are miserable locations for erecting a tent. Ordinary tent stakes pull out of the sand easily. This is especially true of the short, and sometimes flimsy metal stakes supplied with many modern tents. Better stakes for sand can be made or purchased. Longer pieces of steel rod will serve, and are especially important for corner stakes. Some manufacturers offer special sand stakes. At least one makes a stake with a special triangle of steel welded to it for extra bracing in sand.

In addition, you may need to anchor the tent by tying tent ropes to rocks or to logs. If the anchors are too small to hold the tent without sliding, bury them in the sand. Tent poles which might work into loose soil and create slack in the canvas should be seated on flat rocks or boards.

The standing tent should look neat and smooth with square corners and straight ridge and wall lines. Don't tighten the canvas too much.

In rain, or even a heavy dew, canvas shrinks, and although the well-made tent

▲ *External frame umbrella tent is pitched by suspending canvas from frame.*

▲ *All-weather tent is supported by sectional upright poles, nylon guys, alloy runners and pegs.*

Standing tent should look smooth, but don't overtighten canvas. Shrinkage may pull stakes from ground.

may or may not rip from being drum tight, the stakes may be pulled from the ground. This has been known to bring the tent down upon sleeping campers right in the middle of a rainy night.

If there is much chance of rain, loosen the tent ropes slightly before going to bed. Tents with telescoping poles can be loosened by lowering the poles. Interior frames are adjusted from inside.

The ease with which a tent is put up is related to how it was handled when last taken down. With most designs one of the final jobs in striking the tent is to pull the corner stakes. At this point, straighten the walls out one at a time. With a high wall tent, for example, one camper on each end of a wall can grasp the top corners and walk the wall toward the opposite side of the tent until it is smoothed out. Then reverse the direction and walk it back, folding it.

The resulting square or oblong of tenting lying on the ground, flat and smoothly folded, can now be unstaked at the corner. One final step remains.

If the tent requires guy ropes, coil or fold them and lay them inside the canvas before the final fold is made. Leave out one rope long enough to tie the canvas as the final step. A tent bag is good for transport or storage of the canvas. Tent stakes should be wrapped or put in a bag to protect the canvas.

When taking a tent down, keep the canvas clean. Sweep out the floor before striking the tent. Then as the bottom of the tent is folded over, sweep the forest litter, sand or mud from each new fold.

Tents are best left to dry thoroughly in the sun before they are taken down. If, however, they must be struck wet, they should be set up again to dry within 24 hours. Otherwise, mildew may damage the canvas. G.L.

See also: CAMPING; CAMPING EQUIPMENT; HIKING; KNOTS; SURVIVAL.

How to Wind-proof Your Tent

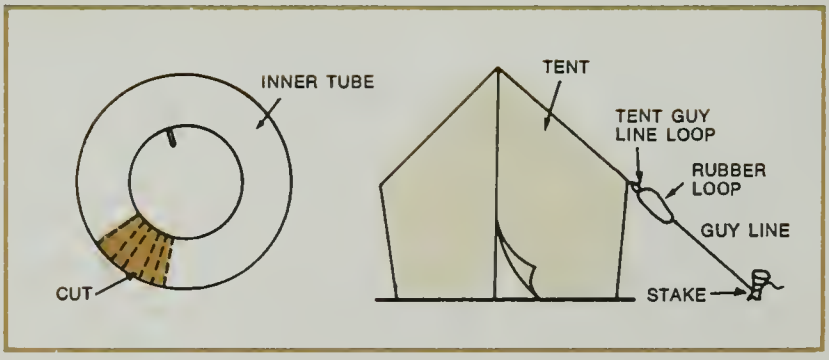
Use rubber loops sliced from an old inner tube to absorb the shock imparted by heavy gusting winds

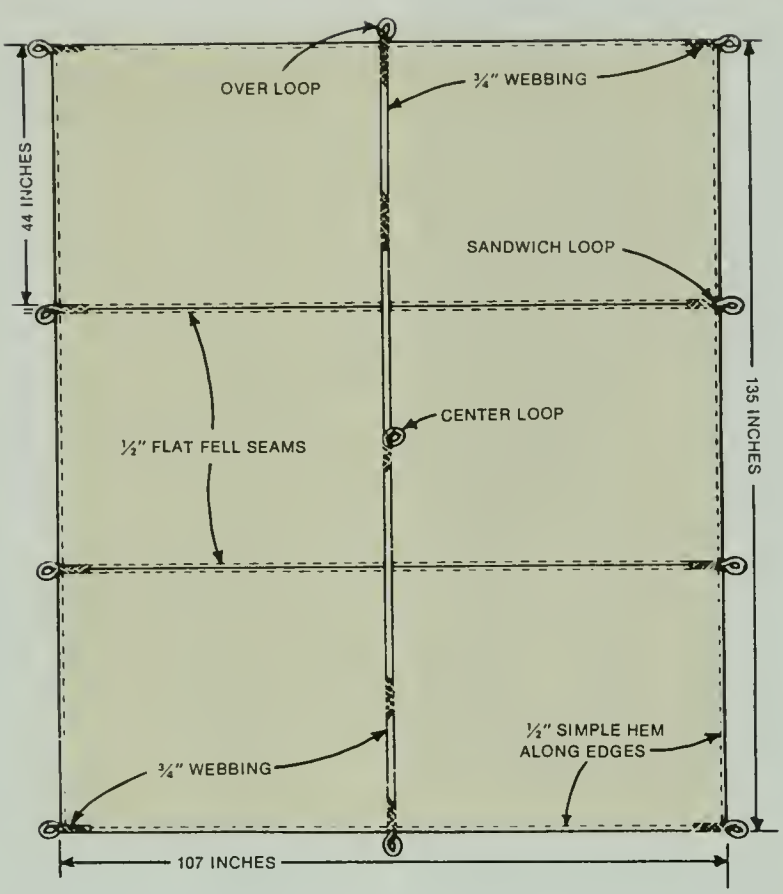
SINCE THE FIRST TENT was pitched, wind has raised havoc with them. Even a moderate gust against the sail-like canvas side exerts a strong force on both tent and rigging. When a heavy gust or, worse yet, a real blow, hits, something has to give. Usually, the worst that happens is that the stakes pull out of the ground. The guy lines won't give, but, if the stakes don't pull free, the side of the tent may rip and this is only less inconvenient than it is expensive.

A simple solution to this problem is to get an old inner tube from your local gas station and cut it sectionally, to make loops that are ¾-inch wide, like big rubber bands.

Tie one end of the loop to the guy line tape on the tent, then tie the guy line to the other end. You now have, in effect, elastic guy lines and no matter how hard the wind blows, the tent can give with the blow. This set-up also eliminates getting up in the middle of the night to replace pulled up stakes and problems that arise from guy lines shrinking in wet weather. P.K.S

See also: CAMPING; CAMPING EQUIPMENT; HIKING.





For a Superior Tent, Make It Yourself

This versatile design can be erected at least 10 different ways, rolls up into a tube 8 inches long and 4 inches in diameter, and weighs less than 4 pounds

FOR YEARS YOU MAY have been struggling along with a number of tents for various camping needs. Your equipment might include a cumbersome 60-pound umbrella tent for car camping, 20-pound PCA-15 for group back packs, a 5-pound mountain tent for solo expeditions, and a few specialized tarps for boat, beach and picnic trips.

Apart from storage problems, each has only one use, and each was a masterpiece of inflexibility—going up in its own way, incapable of being adapted to changing conditions, and circumstances. What is needed is a tent that will be ideal for all types of back packing, as well as car camping, boat trips, fishing and general use; weigh around three pounds and store compactly; sleep up to six people; pitch quickly

in a variety of ways; hold up in wind, rain or snow; and adapt to any terrain—turf, sand, ice rock.

All materials weigh little over three pounds. Stitching takes about three hours of steady work.

It rolls up into a tube 8 inches long and 4 inches in diameter, and goes up easily in at least ten ways. It passes all tests in 40-knot winds.

The following directions will enable anyone to make the V-Fly after purchasing the materials, which are available—direct or by mail—at most equipment stores:

1. Note diagram.
2. Cut fabric into three equal lengths.
3. Line up the three lengths side-by-side and stitch together, making a flat-fell seam consisting of five stitches. Use Taslan nylon thread.
4. Make a half-inch hem all around the fly and triple-stitch. Fly should now measure 135 x 107.
5. Cut webbing into one 12-foot length and 8 one-foot lengths. Heat-whip the cut edges.
6. Fold the 12-foot length in half and triple-stitch ½-inch back from fold. Place the loop dead-center on the fly, stretching the two ends out along the middle of the 135-inch length of the fly. This forms the spine of the fly and should be securely stitched, with center loop up.
7. Four inches of webbing will now overhang each end of the spine. Fold 3½ inches back under the fly, forming a ½-inch loop, and triple-stitch in place.
8. Fold the 8 one-foot pieces of webbing in half, stitch each ½-inch back from mold. Stitch these to the four corners and four seam edges, with fabric sandwiched between.
9. You will now have eleven loops. Insert a #103 rubber band in each. These are the shock-absorbers in pitching your fly, and are to be looped over poles and pegs, to reduce fabric-strain.
10. Cut the nylon cord into two 7-foot lengths, heat-whipping the ends. Rig each length to a guy line tightener. These form the pole guy lines.
11. The balance of the cord (11 feet) should now be cut into two 3-foot lengths and one 5-foot length and heat-whipped. These cords are for use on corner and center loops as needed.
12. Stretch the fly out firmly in a simple lean-to and waterproof all seams, loops and stitching using special nylon waterproofing liquid. Check the results with water (especially the spine) and repeat process if water does not bead off the sewn areas.

You are now ready to pitch your fly. And using it in all its variety is simple enough with a little experimentation. R.W.

See also: CAMPING; CAMPING EQUIPMENT; HIKING.

MATERIALS LIST

Quanity	Size and Description	Purpose
9 yards	46″ Urethane-coated ripstop nylon threadcount 112x100	tent
2	⅝″x42″ 3-section aluminum	poles
20 feet	medium nylon webbing	reinforcement
25 feet	braided nylon cord	guy lines and loops

NOTE: Also need 7-inch pegs, guy line tighteners, #103 rubber bands, Taslan nylon thread and nylon waterproofing liquid.

How to Repair and Maintain Your Tent

Most tent repairs are easy and inexpensive. Make them and your tent will give you 20 or 30 years of dependable service

Tent damage like this is usually left to the professional but if it happens in the field, you would be better off if you knew how to repair it yourself. Better still: forestall this kind of damage by making repairs when the damage is small.

YOUR MODERN TENT should yield a good serviceable life of 15 to 20 years. It is not inconceivable for it to push the three decade mark. Or it could hit the dust within five years.

No one can tell you or guarantee how long your particular tent will last. We will assume, though, that you purchased a quality, name-brand tent in the first place, and chose it with your family's camping habits in mind. From then on, how you treat it will make the difference.

Proper care is necessary, and a major factor in determining the tent's serviceability and life span. Inevitably, no matter how meticulously you care for it, aging and wear and damage will occur.

Think back to last season. Have you noticed minor leakage. Zippers that don't work properly? Little tears? Grommets or snaps that are pulling loose? Ropes that are frayed or maybe even broken?

So often necessary repair work is avoided and not taken care of by the tent owner. Mostly he feels it costs too much to take it to a professional repairer (most tent repairers do charge a minimum fee for repairs, no matter how small the job is); and the chore seems too much a matter of experiment, "take your chances" and makeshift supplies.

Yet an owner of a third generation—and now in its tenth decade—tent and awning company states that these and most other tent repairs can be handled quite professionally at home with the minimum of instruction. Indeed, they should be attended to before the problems become frustrating, or worse, irreparable. And wise are those that make the effort to repair, for it could well double the life of their original investment.

A brief rundown of a tent's properties might prove to be the best introduction to

tent repairing. By far a tent's major component is the canvas. This is usually all-cotton material, with the heavier, more durable weights in the roof, medium weights in the walls, and lighter weights in the floor. Cotton is used because it breathes, providing good tent ventilation and circulation. Its fibers swell when they are wet, making the cloth firmer and tighter, increasing its strength by a quarter, and actually waterproofing itself in the process.

Nylon tents, coming on strong, require two layers to give the same degree of water-repellency.

Even so, factory finishes are added to further water-repellency and provide mildew and vermin resistance. Some manufacturers feel they counteract the elements even more by incorporating a vinyl surfaced floor on an aluminized roof.

Further ventilation and esthetic considerations are added with screening. Supporting and suspending the tent are the poles and frames. A combination of stakes, ropes and grommets anchor it down. And finally, zippers and snaps button it up and batten it down.

To begin repairing, first the canvas should be checked for tears, holes and worn or rotted spots. Those in the walls and roof will show up easily if you search for them from the inside of an empty tent on a bright sunny day. Pay particular attention to fold lines, corners and seams—anyplace where a crease might weaken fibers. Thoroughly inspect aluminized roofs and vinyl-treated floors, for these have a tendency to crack more easily than does just plain canvas.

Straight rips in the canvas—in corners, and along seams—can be mended and closed with a close overcasting stitch using

Tent patches are easy to make. Just apply cement to the patch and to the area around the hole. Press the patch over the hole.

The easy way to check for damage is from the inside. Just look for places where light shines through.

➤*Sloppy repair jobs like this one may come apart when you most need the tent.*

a heavy waxed cotton or cotton/dacron thread. Nylon thread is not recommended for tent sewing as it does not weather well and it stretches. Cotton swells when wet and this will seal the needle holes.

If a seam line has been known to leak along the stitches, a candle or household wax can be rubbed along the seam to wax and fill it. (Often a thoroughly dry tent will show pinholes of light through the seam stitch lines. This does not necessarily mean it will leak. Remember, the holes seal themselves shut when wet.)

Tears, holes or worn spots, even sizable ones, are most easily repaired by using patches of canvas tenting material and bonding them over the holes with canvas cement. Your tent material might be drill, twill, duck or possibly even poplin. And it could be any one of an infinite variety of colors. Furthermore it could be faded somewhat from the elements. So don't be disappointed if you can't match the canvas color. Find a seven to eight ounce per square yard canvas, in the nearest color. One yard is usually enough for numerous small patches now and in the future.

Most modern tent screening is almost indestructible. Screening is probably the most difficult chore for the home repairer, because of its open weave. Using a cotton-type thread again, tiny holes and slits can be closed by overcasting with a close, fine stitch.

To repair holes, nylon netting is much preferred for replacement screening. Saran netting, though not as widely used or available, is also good. Steer clear of fiberglass. While still recommended and used by some manufacturers, it has a tendency to split and crack.

Large holes in the netting can be replaced by cutting a patch of net larger than the hole. Turn the raw edges of the patch under about ⅝-inch, pin it in place, and stitch the edge of the patch to the window. Go to the other side of the netting, turn under the raw edge of the hole side, and stitch together again.

Although a professional look cannot be obtained when replacing an entire screen, this repair can be done. Closely cut out the old screen. Cut a new piece of netting about two inches wider and longer than the opening. If a seam has to be made because the netting isn't wide enough, use a flat-felled seam and sew it together by machine. (In cutting, don't forget to make an allowance

for extra material when this seam is needed.) Turn under the raw edge of the new netting about ½-inch and encase the edge, by machine, in a wide double-fold cotton bias tape (available in sewing departments). Sew this in by hand to the inside of the opening. It is easier to sew this bias taped edge to the tent than to hassle with a flimsy edge of netting.

Next check the poles and frames. It is not unusual for poles and suspension frames to become damaged, bent or otherwise inoperable—especially in most of the newer telescoping varieties. These incorporate all manners of spring and lock mechanisms.

The straight, canopy, aluminum, telescopic replacement poles are all widely available. But when it comes to those suspension frames it's a different story. There are about as many types of these as there are manufacturers and tents, and they are often the hardest item to find. Sometimes custom tent manufacturers can replace parts of pole sections if you can show or explain to them just exactly what you need. More often than not you will have to go back through your dealer or tent manufacturer to replace them.

Check for split or otherwise damaged stakes. The least expensive way to replace them would be to make new ones out of hardwood, cutting them about one inch square and 9 to 12 inches long. Point the bottom ends and rope-notch toward the top. It's actually easier, less time consuming and probably more economical in the long run to purchase new stakes. (Ready-made wood stakes are about one-third the cost of steel ones, but still are hardly worth it since you can make your own.) On the other hand, the durability of the steel stakes far outweighs their cost. The new high-impact plastic stakes, though still held in reserve by many, are drawing considerable favor in the tenting industry. Aluminum is not recommended for stakes, as it bends easily.

Each rope should be checked along its entire length. A rope, even though it is basically in good shape, is only as strong as its weakest point. Ropes can be replaced individually if unexpected damage has occurred only here and there. But generally when rope starts to go, it's worth your while to replace it all.

Two types of rope can be used—weather-treated manila, which is cheaper, weaker, and harder to manipulate when wet, and hollow-core or braided (not solid) polypropylene, which is more costly, more weather-resistant, and twice as strong, though somewhat harder to knot securely. Nylon roping, while used almost exclusively in mountain climbing and other duties where great strength and stretch are desired, is not favored for guy ropes or tenting.

Rope is measured in 32nds. A #4 rope is 4/32-inch, #8 is ¼-inch, and so on. Tent roping could vary from #4 to #12. In replacing it: evaluate which type of rope you will use, (polypropylene can understandably be used in a smaller size); check which size or sizes came with the tent originally. Replace accordingly.

Check to see if any grommets have pulled or are pulling loose. There are replacement grommet kits available. However, there is an easier, cheaper, more professional and more satisfactory way of replacing missing grommets. Simply insert an eyelet ring (available at sewing counters in various sizes) in the missing grommet's place. Sew it in with an overcasting stitch: around the ring, through the hole, etc., closely all the way around until it looks much like a buttonhole.

Probably all a sticking or hard-working zipper needs is a little lubrication with powdered graphite. If it is damaged or broken, heavy-duty weather resistant tent zippers are available. These are sewn in by hand for at-home repairs. For this and all other hand sewing use a darning or upholstery

Inspect all lines for signs of fraying.

Nylon netting seldom needs replacement, but seams can wear so check them well.

needle. And don't forget the old-fashioned thimble, for your fingers' sake.

An occasional damaged snap can be replaced with a replacement snap kit. It would be much more satisfactory, however, if you ever need to repair a snap-closed door-opening to do it with zippers.

Steer clear of the seemingly easy to use and much advertised self-adhesive patches and self-adhesive tape-mounted snaps and grommets. Custom tent manufacturers and repairers have found not only are they more expensive, but they tend neither to weather well nor stand up under heavy tent usage.

If you experience tent damage that you either cannot or choose not to repair yourself you can take it to a professional repairer. These repairers caution: Mark with chalk or tag in some manner the area to be repaired, and have your tent clean. If not cleaned beforehand, the tent may cost more to repair because the repairer will either have to clean it before repairing, or charge you for having to clean up his machines afterward.

After all the repairs are made you can re-treat the tent to make it water-repellent (tents are never made waterproof but rather water-repellent). There are two types of water-repellent compounds. Wax and silicone. What you use will depend on what was used on the tent originally. An older tent with a wax finish will feel heavier and stiffer, sometimes even feel waxy to the hand. If you have ever experienced color rub-off with your tent, it probably has a wax finish. Most of the newer tents have been finished with a dry or mineral dry pro-

cess which adds no appreciable weight or filling to the fabric. This fabric will feel much softer and flexible to the hand. On these you use the silicone water-repellent. If in doubt, contact a canvas manufacturer and he can tell a finish at a glance, or by the model number.

Water-repellent compounds are available in aerosol spray cans for first-aid repairs, but for large jobs buy it by the gallon and use a paint brush. One gallon covers about 100 to 125 square feet. A 10 foot by 12 foot tent would take four to five gallons. It should be applied on a thoroughly dry and clean tent. (To wash a tent, hose it down, and be sure it dries out thoroughly before treating with water-repellent.) Pick a warm sunny day with no threat of rain. Start early so the water-repellent compound will have ample time to dry before you pack the tent away. Protect the ground with a plastic tarp, as these compounds can ruin grass, at least temporarily.

Fortunately, in recent years, enough stores have been answering the public's need for do-it-yourself tent repair supplies to make them generally available. Although all stores may not carry everything, most of the major mail order houses that deal in general merchandise carry some supplies. The selective sporting goods mail order houses generally carry a good supply. Retailers and sporting goods stores which cater to the tenter trade are another possibility. Furthermore, some custom tent and tarp manufacturers and repairers will do their best to fill orders either in person or by mail if you specify exactly what you need, how much you need, color, size, etc.

After you have your tent back in shape don't forget that a few preventative measures will go a long way to keeping it that way. The two cardinal rules of tent care: Keep it clean and keep it dry. Proper care can, in fact, reduce repair work by half. And proper and prompt repairs—don't forget that small store of tent repair supplies when you're out in the field—can double the life of your tent. J.L.R.

See also: CAMPING; CAMPING EQUIPMENT; HIKING.

TENT REPAIR SUPPLIES

*__Canvas__—Cotton (duck, drill, twill, poplin). Varying widths. Varying weights. Sometimes available in colors.
__Nylon screening__—Usually in olive drab, 40 to 50 inches wide. White is available but not recommended as tent screening.
__Aluminum telescoping canopy poles.__
__Suspension frames.__
*__Stakes__—Wood, steel or high-impact plastic, 9 to 12 inches long.
*__Grommets and snaps__—Varying sizes. Available in complete kits. (Eyelet rings cost only a few cents.)
*__Ropes__—Manila, weather-treated manila, polypropylene. Varying diameters and lengths.
__Zippers__—Heavy-duty, weather-resistant, dual-pull in varying lengths.
*__Thread__—Cotton or cotton/dacron. Sometimes in colors, usually only white. Heavy-duty carpet and button thread is also satisfactory; wax it by pulling it over a candle or a bar of wax.
*__Waterproofing__—Wax or silicone spray or bulk.
__Vinyl sealant__—Spray (only for surfaced floors).
*__Canvas (and vinyl) cement__—Available in 2-ounce tubes and up.
*__Candle__—(Or household wax.)
NOTE: Items marked (*) are for basic tent "first aid kit."

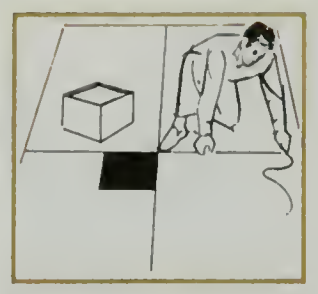
Installing Carpet Tile

Carpet tiles are suitable for kitchens, baths or any other room in your house. They are easy to apply and if you mix colors you can achieve striking designs

PRE-GLUED CARPET TILES are easy to install. They come with an adhesive already applied and are packaged with a protective sheet that peels off easily, leaving the carpet tile ready to be pressed into place on the floor. Others are packaged back-to-back. Just peel them apart and stick them in place. The job is neat, clean and professional looking, and your fingers do not stick together. Carpet tile is available in 9 x 9-inch squares and 12 x 12-inch squares. One 9 x 9-inch tile equals 9/16 square foot, and it is sold in cartons containing 27 square feet (48 tiles). At least 10 per cent extra should be ordered to take care of the fitting, cutting and trimming. Let your local dealer figure how much tile you require. Just bring him the measurements of your room. Once the quantity has been determined and style selected, get the tile home and store it in the room where it will be installed, because the room and tile should be kept at 70°F for 48 hours before and after installation as well as during laying of the tile.

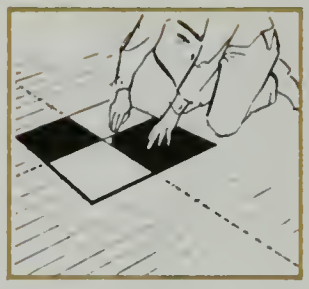
Lay out your room. It is best to start working from the center of the room out-

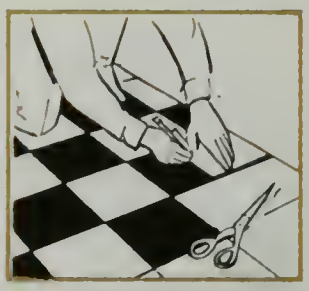
tile, ceiling: see ceiling tile



Use chalkad string to find center of room. Use a tile to make sura the lines ere perpendicular to each other.

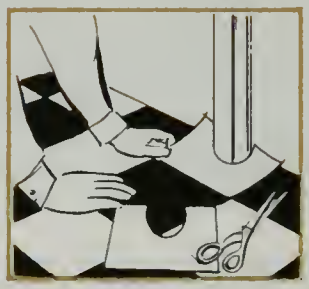
Start laying the tiles at the center and work outward toward the walls.



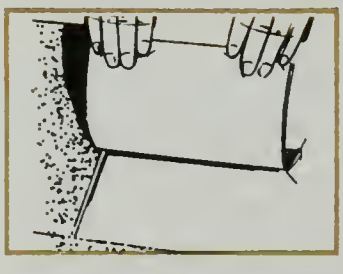


How to fit border tiles. When you get to the next to last tile in a row, put it in place loosely. Place a second tile over it butted against the wall. Use the outside edge of the tile against the wall as a guide to mark the loose tile beneath it and cut the tile along the mark.

Some carpet tiles can be removed and put back easily. This is handy if you want to take a tile up for cleaning a heavy stain or if you want to shift tiles around to compensate for wear in heavily trafficked areas.



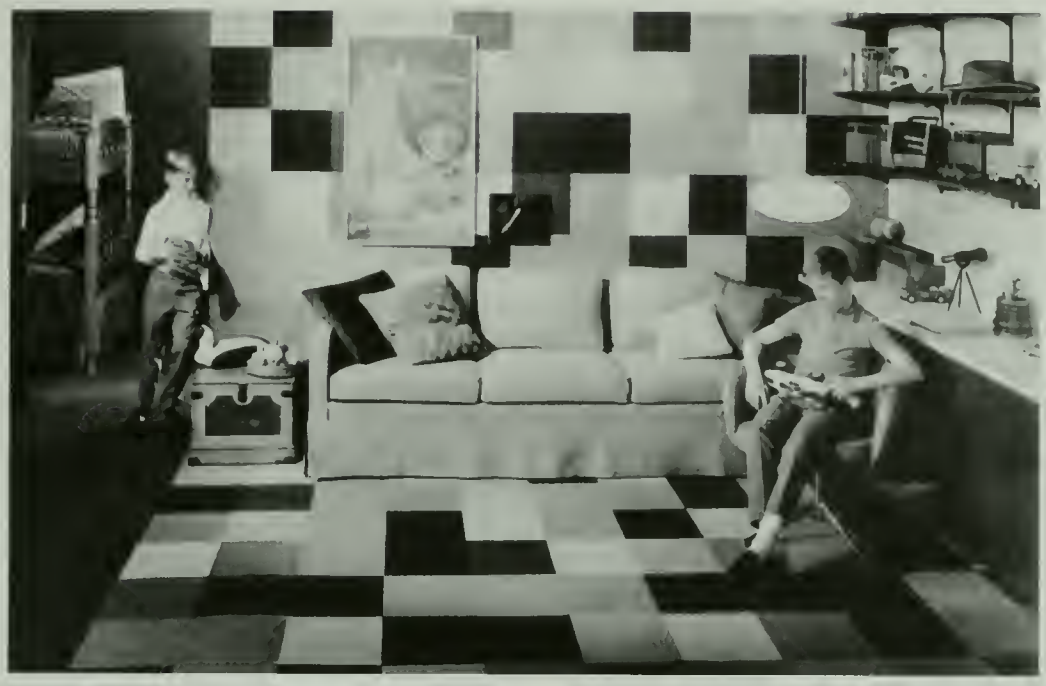
Tiles don't move when you vacuum them. Usually, they can be washed, as well, but don't flood them with water.



Use a template of heavy paper or cardboard to gauge fit around pipes, radiator legs or other irregularities. Transfer the shape to a carpet tile; cut it out.

ward. To find the center of the room, measure the wall-to-wall distance at each end of room (disregard alcoves, offsets or other breaks). Attach a string at center of the floor at each end. Rub the string with chalk. Then stretch the string tight and let it snap to mark chalk line on the floor. Find the center of the chalk line, and then mark another chalk line at right angles to the first, using a square or tile as a guide.

Plan your area. Lay a row of loose tiles (don't remove backing) along the chalk line from the center point to one side wall and one end wall. Measure the distance between the wall and the edge of the last tile. If less than two inches or more than eight inches (ten inches for 12 x 12-inch square tiles), move that center line (resnap new chalk lines) 4½ inches closer to the opposite wall. This will improve the appearance of the floor and eliminate the need of trying to fit small pieces of tile. Check ac-



▲ *Try a mosaic of several colors, and run the design up the wall for an interesting decor.*

▼ *Border strips of a contrasting color are easy to make with carpet tiles.*

curacy of the crossing chalk lines. They must be at right angles or your design will not be even.

Laying the tile. Remove the release paper from the back of each tile or peel two tiles apart just before you put it in place. It is not advisable to remove the paper from several pieces at a time. Start laying tile from the center point, being sure the first tiles are flush with the chalk lines. Do not slide tile into place; butt each tile squarely to the adjoining tile. Have the corners meet exactly. Do not apply pressure to the tile until it is accurately placed because once pressure is applied, the tile is difficult to remove.

Always be sure that you cut the tile before removing the release paper. Cut on release paper side of tile, in other words, with the release paper side up. To fit around obstacles or at the edge of the room, cut with shears or a straight-edged and sharp linoleum knife. Heating tile over a hot plate will facilitate cutting.

To fit border tiles, place a loose tile exactly over the last tile in that row. Take another tile and place over the first tile. Butt the second tile against the wall and mark the tile beneath with a pencil along the edge of the upper tile. Cut the first tile along the pencil line.

To fit around obstructions, simply make a paper pattern, trace it onto the tile, and cut. Radiator legs should never rest directly on tile; fit tile around the legs. Other tile works a bit differently. Cut a piece of cardboard to the size desired. Trace the outline with a soft pencil on the foam side of the tile and cut with scissors or razor.

Wait several days before you wash your new tiled floor. Give it time to "set-up." If cleaning becomes necessary, use a damp cloth or mop—never flood the floor with water. Use a mild cleaner, after sweeping up loose dirt. The rug tile can be cleaned immediately if necessary, as you would any carpet. When you have finished the kitchen or bath, you may want to take a second look at the other floors in your home.

See also: FLOORS; FLOORS, BRICK; FLOORS, TILING.

➤ *Interesting effects can be achieved by mixing a variety of colors and textures of carpet tile.*

Decorate Your Fireplace with Ceramic Tile

This design will transform a traditional appearance into a modern one, although with other tiles you can achieve almost any look you desire, as well as increase the durability and ease of maintenance of any wall or floor in your house

IF YOU WANT TO TRADE in the traditional look of brick for a sleek, modern appearance, you can resurface your fireplace and the area around it with ceramic tile.

This kind of project uses the same principles that are used in setting tile in any other portion of your home—bathroom or kitchen for example—so once you complete the fireplace, you will have the skill and confidence to go on to bigger things.

The advantages of tile over most other surfaces are that it is easy to maintain, wears out only under extreme abuse or age and resists dirt and grime. In addition it comes in an almost endless variety of color, texture, size, shape and design. Tile is considerably more expensive per square foot than some other wall and floor coverings and it takes time to apply, but both these disadvantages are offset by the fact that tile will outwear almost anything else and that it can appreciably increase the net value of your home.

The fireplace and hearth may be covered with either glazed or unglazed tiles, but do not use tiles in the firebox itself. The only material suitable for the firebox is firebrick.

The small, unglazed tiles used in the design illustrated here are called ceramic mosaics. For easy application they are mounted on 1 x 2-foot sheets in exact position. The ones used here are face mounted—that is the faces are covered by a removable adhesive paper—but others are available that are back-mounted to mesh. The mounted tiles are installed as a unit—sheet by sheet—rather than one at a time.

Glazed wall tiles, ordinarily 4¼ x 4¼ inches square, can also be used on fireplaces. In this project they are used on the

tiling floors: see floors, tiling
tinder: see campfires

hearth apron. These glazed tiles are available in a wide range of colors, designs and glazes including heavy-duty glazes for use on floors. They come as single tiles or are back-mounted 9 or 12 tiles per panel.

Also suitable for the hearth apron would be quarry tiles. These heavy-duty floor tiles traditionally are 6-inch squares in earthen colors, but now they are available in additional colors and decorative shapes and may be textured or glazed.

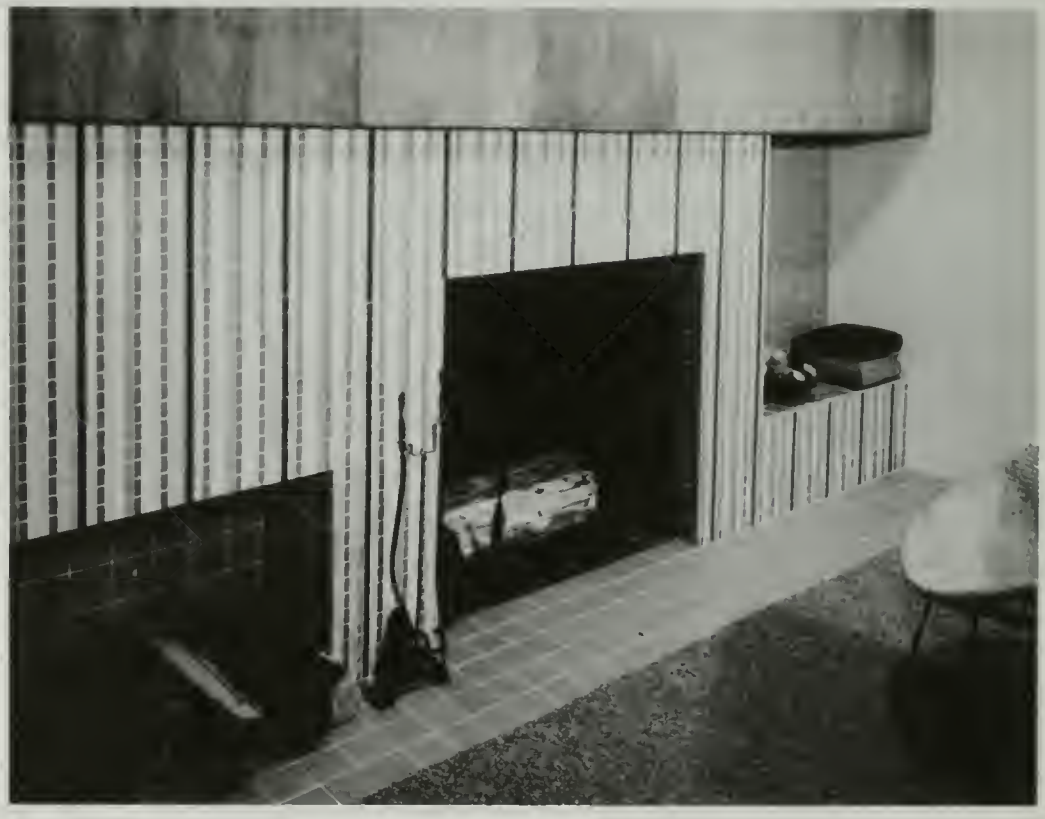
Tile is set with inexpensive tools, many of which are already around most households. They include an ordinary glass cutter, carborundum stone, pliers or nippers, plastic sponge, paint brush, squeegee or grouting trowel, rubber gloves, a notched trowl, clean cloth, thinner or solvent for cleaning up excess or spilled adhesive, carpenter's level and plumb line. In addition, a tile cutter, which can be rented from most dealers, will speed the work considerably.

Once a plan has been determined, spend time with a tape measure. Take each dimension carefully and record it accurately. This is important not only for the preliminary construction required prior to tile installation, but to assist in ordering the correct quantity of materials.

To order tile, after all surfaces to be tiled are measured, consult your local ceramic tile dealer for help in converting dimensions to the quantity needed.

Next, frame the recessed shelf and log storage spaces flanking the fireplace and cover all areas to be tiled with gypsum wallboard. Apply the wallboard directly to the old brick fireplace with hardened ma-

Tiling of fireplace area transformed the character of this room from traditional to modern.



▲ *The first step is to measure and record every dimension accurately. This is necessary for the preliminary framing and construction of the plasterboard surface as well as for ordering the tile.*

sonry nails. The wallboard provides a smooth, uniform surface for setting the tile.

All joints in the backing material should be sealed with spackling compound, covered with tape and spackled again. Sand away excess spackle after it has dried. Be sure to use spackle designed for plasterboard joints.

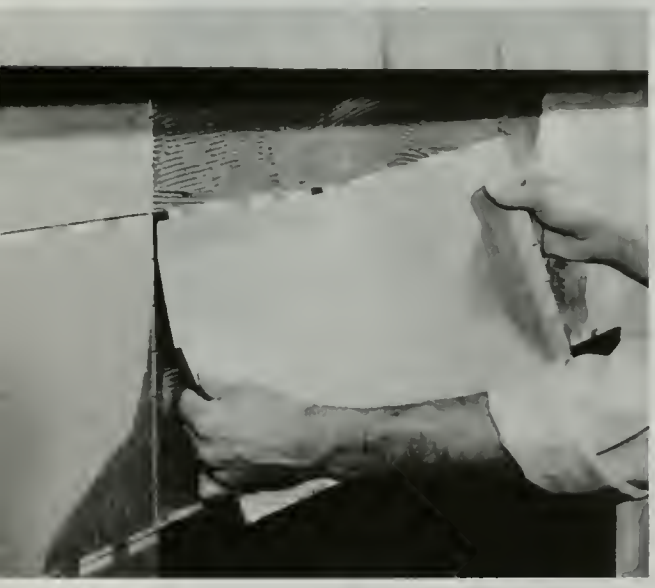
All floor area to be tiled on either side of the hearth should be covered with ¾-inch exterior grade plywood. A separation of $\frac{1}{16}$-inch should be left between sheets of plywood and walls to allow for expansion. All nails should be flat head, preferably screw-type and countersunk flush with the surface.

If the hearth directly in front of the fireplace opening is made of brick, it is best to cover this with a thin coating of Portland cement mortar. This will bring the hearth level with the plywood surface and provide a smooth, clean surface for installing the tile.

Dry-setting Portland cement mortars or organic adhesives may be used to set ceramic mosaic tiles. However, the strongest adhesives available are two-component epoxy adhesives designed for ceramic tile installation. When using this type of adhesive, follow manufacturers instructions carefully, including wearing rubber gloves.

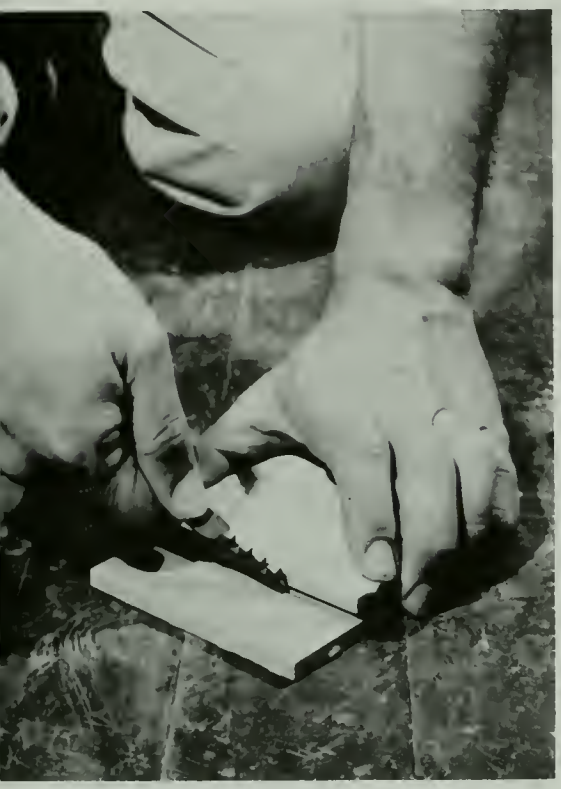
Use a notched trowel of the size recom-

▲ *Providing a sound base for the tile is important. Be sure to tape and fill all plasterboard joints and fill all nailholes with plasterboard spackle. Area of floor to be tiled is covered with exterior grade 3/4-inch plywood. Fill area over brick hearth itself with Portland cement mortar flush with the plywood.*



▲ *Tile adhesive is spread with a notched trowel. Be sure to use the size and type specified by the manufacturer of the adhesive. The face-mounted tiles are applied a sheet at a time.*

▼ *Small unglazed tiles are cut with a nipper. A rubbing stone is used to smooth the cut edge.*



mended by the adhesive manufacturer to spread the adhesive evenly and thinly so it won't build up and ooze through joints onto the face of the tile. Don't cover too large an area before you start applying tile because the adhesive might harden too quickly.

After spreading the adhesive, the mosaic tile sheets should be put in place sheet by sheet with the paper side out. Once positioned correctly, they should be tapped firmly into the adhesive.

Cutting ceramic mosaics is done with

Glazed tiles are more difficult to cut than unglazed tiles. To do it, first score the cut on the glazed face of the tile with a glass cutter. Another tile can serve as a straightedge. Lay the tile face up over a metal rod or similar hard, thin object with the score over the rod and press each side down, applying pressure slowly until the tile snaps along the score. Smooth edge with the rubbing stone.

Use a squeegee or a grouting trowel to spread grout. Force it into the cracks between the tiles and scrape away the excess.

After tiles are in place, soak backing with water and peel it off. Clean up excess or spilled adhesive and tiles will be ready for grouting.

ordinary pinchers or pliers. Just clip off the excess and smooth the edge with a carborundum stone.

After the entire fireplace wall area is tiled, the paper should be moistened with water and stripped off. Each tile remains bonded in exact position, permitting professional looking grouting. At this point the job should be allowed to set for 24 to 36 hours to permit the adhesive to cure before grouting.

Grouting—filling the joints between the tiles—is the next step. But before applying grout, clean all joints, remove dust, dirt and any excessive adhesive. Adhesive can be removed with adhesive thinner.

The recommended grout for ceramic mosaics is Dry-Set which is available in either grey or white. If it is not available pre-sanded, follow instructions for the proper proportion of sand to be added. To maintain a white joint be sure to use white sand.

Spread the grout over the tile face and work it into the joints. A squeegee or special grouting trowel helps force the grout deeply into the joints and scrapes off much of the excess.

After the grout has become firm, use a clean wet cloth or sponge to wipe away the final film of grout and, finally, polish with a clean dry cloth to bring out the beautiful tile luster.

Since the floor area to be tiled on either side of the hearth is covered with plywood, Dry-Set mortar should not be used since it does not bond tile satisfactorily to plywood.

Use an organic adhesive or the epoxy resin adhesive. Trowel the adhesive directly onto the plywood. Use a dry-set mortar on the cement. Again, do it sparingly and evenly.

Each glazed tile should be pressed firmly into the adhesive bed and snugly to its neighbor. Glazed tiles manufactured in the United States are produced with small projections on all four edges to assure uniform spacing automatically. If the tiles you are using do not have these projections, space them with two toothpicks inserted in each joint. Remove toothpicks before grouting.

Cutting glazed tiles is a slightly more involved operation than cutting unglazed units. However, with reasonable care a successful job can be done. Use a glass cutter to score the glazed side. A straightedge or another tile will guide the cutter.

The tile should then be rested, glazed side up on a nail or similar object. Apply pressure gradually and evenly until the tile snaps along the scoring. Smooth rough edges with rubbing stone. Again, after all tile is set, allow at least a day before applying grout. The purpose of the wait is to allow time for the solvent in the adhesive to evaporate.

The same grouting and cleaning rules apply to glazed 4¼-inch tiles as to unglazed mosaic tile but sand should not be added to the Dry-Set grout.

See also: BATHROOMS; FIREPLACE; FLOORS; FLOORS, BRICK; FLOORS, TILING.

After the grout has been applied, use a wet sponge to wipe away any excess. When the grout is set and the surface is dry, polish the film from the tile with a soft, dry cloth.

How to Buy and Maintain Automobile Tires

You can add miles to the life of your tires and improve the safety and comfort of your ride by choosing and taking care of tires correctly

HOW CAN YOU BUY safe tires, keep them safe and make them last longer? Many people do not give these topics much thought, figuring that's for the manufacturer to worry about.

True, the tire maker must build a safe tire, and if he makes a defective one, he must recall it for replacement. The Federal Government does give you a bit of help with its safety regulations.

Most of the job, however, is up to you. What is safe for one car is unsafe for another, or perhaps even if safe, needlessly expensive. The raw information about a tire is readily available; knowing how to interpret it is another matter.

Today's super tire is the radial. It is optional equipment on most American cars after decades of success in Europe, and American tire makers are finally producing it. Yet despite its rave notices, the radial is not everyone's tire. Here are the facts you must consider.

First, look at tire construction. All modern tires consist of four basic components:

1. The carcass, or casing.
2. The bead—the steel wire-reinforced edge that keeps the tire on the wheel rim.
3. The tread—the flat, grooved "footprint" that is in contact with the road.
4. The compressed air inside the carcass that supports the weight of the car.

The tire is expected to provide reasonable traction for acceleration and deceleration on all types of surfaces; adequate lateral adhesion for safe cornering; a "comfortable" ride (each to his own definition of what that is); low noise level; adequate tread life; resistance to damage from impact, heat, flexing and weather; and safety at normal speed.

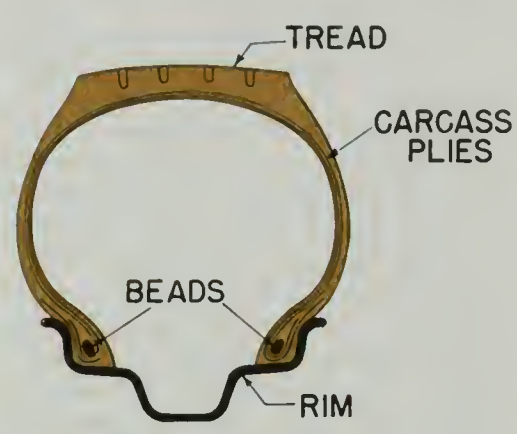
To some degree, improving on one function of a tire can hurt another. For example, a tire built with traction maximized might get its traction from a soft tread rubber and it might wear bald in a few thousand miles. One tire, no longer made, was famous for its traction on dry roads, but was terrible for traction on wet roads.

Some tires have been made with tread rubber that was extremely long-lasting, but the traction was inadequate.

A tire with stiff sidewall has excellent resistance to impact from sidewalk curbs and other hazards that afflict sidewalls. However, its lack of flexibility sharply reduces cornering power and increases tire wear.

Basic tire design. There are three basic tire designs in use today: the radial, the belted bias-ply and the conventional bias-ply.

The oldest type is the conventional bias-ply. The carcass of this design is made up of rubber-encased layers of cord that cross each other at an angle, generally about 35 degrees. This type provides a very comfortable ride, particularly if rayon is used as the cord material. Nylon provides the best strength, but it flat-spots, that is, it temporarily loses its roundness when the car has been parked for a few hours. This results in a bumpy ride for the first few miles.



▲ *The basic anatomy of a tire.*

At one time, there were four layers of cord (a few tires, intended for heavy-duty use, had six or eight). Then the tire manufacturers began to make tires with two layers, also called "plies," but called them "four-ply-rated" tires. This meant that the two plies were as strong as the four of older designs. This was true, but the public refused to accept it, and two-ply bias-ply tires are not popular.

The two-ply design gained acceptability only with the belted bias-ply tire, however. In this design, there are two or four belts, made of any of a number of materials, installed around the tire circumference, between the layers of cord and the tread. They brace the tread so that it rolls true. The truer a tread rolls, the less is the resistance and because tread distortion is less, the tread runs cooler and lasts longer, and the reduced resistance means more gas mileage.

Reducing tread distortion, or "squirm" as it is often called, would seem to be pure advantage. The fact is, however, that a squirming tread absorbs quite a bit of road shock, improving the ride. In fact, squirm is

▼ *In conventional bias-ply tire (left), cords cross at an angle. In a radial-ply (right), cords run straight across and there are tread-bracing belts running circumferentially around the tire between the plies and the tread. Belted bias-ply (center) combines both, with cords crossing at an angle and belts running circumferentially around tire between plies and tread.*

the major reason for the smooth ride of a conventional bias-ply tire. Squirm has so many disadvantages, however, that the tire manufacturers prefer to improve tire ride with better design of a belted tire.

A lot of experimentation is done on the belt materials, which include steel wire, fiberglass, polyester, nylon and rayon.

The radial tire is everyone's idea of the ultimate. It didn't catch on in the United States until recent years, primarily because of its cost. The radial is perhaps twice the price of a simple bias-ply, and its sidewall strength is poor. Also, car suspensions must be turned for radial, or its ride is very harsh, particularly at lower speeds.

The radial design itself looks simple. The plies run straight across the tire cross-section, from bead to bead. The tread area belts run at a 90-degree angle to the cords.

Cord and belt materials are the same as for belted bias-ply.

The radial has even less tread squirm than the belted bias-ply because the sidewalls are so flexible. This is an inherent characteristic, the result of their straight-across pattern compared with the crossing of cords on the bias-ply.

During cornering the sidewalls flex to absorb the cornering effort. In a bias-ply, the stiff sidewalls don't give very much, and there is some lifting of the tread.

The sharp reduction in squirm and the resulting truer roll means even better gas mileage, cooler running and longer life. At a time when emission controls are sharply reducing gas mileage, a tire that improves it, even a little bit (up to five per cent over a bias-ply and perhaps two to three per cent over a belted bias-ply) is worth noting.

Radial tires handle differently from bias-ply tires. They grip the road a lot better, and this has caused some controversy. It's been claimed that the radial is dangerous, because it holds and holds and suddenly lets go. The fact is that a radial holds on well past the average driver's cornering

NAME OF TIRE
MANUFACTURER'S NAME
4 PLIES UNDER TREAD (2 XXXX CORD) + (2 XXXX CORD)
SIDEWALL 2 PLIES XXXX CORD
DOT XXXX XXXXXX
MAX LOAD 1500 LBS @ 32 PSI MAX PRESS.
LOAD RANGE B (4 PLY RATING)
F78-14 (REPLACES 7.75-14)

U.S. Transportation Department requires much information on the tire sidewall, including size, maximum inflation pressure and type of construction.

technique. Some radials give very little warning when they're at the limits of adhesion, but others definitely let you know how hard they're trying.

The steel wire belted radial is the most expensive, but it's a favorite wherever road hazards are a problem. Although rayon is basically noted for its smooth ride, it is definitely also possible to build a quality rayon radial. Pirelli of Italy has been doing it for years, and although the Pirelli rayon radial doesn't have the life of steel-belted radials, its ride is excellent and its handling characteristics take very little getting used to. However, the U.S. public has been sold on steel-belted radials and this is what most companies are making.

Which to buy. If you really drive a car hard, particularly do a lot of secondary road cornering, the radial is your best choice. If the roads you travel are in poor condition, steel belts should be your choice. Otherwise, the less-expensive fabric design should do fine.

If you drive rather conservatively except for some high-speed runs now and then,

the belted bias-ply is suitable. It has the advantage of being compatible with ordinary bias-ply tires, which permits you to use the inexpensive bias-ply snow tire, which will get little abuse and normally dies of old age rather than wear. Radial-ply tires are not compatible with other types, so you'll have to use radial snow tires, which are expensive.

On an older car that you're just trying to keep going for a year or so, why spend more than for a bias-ply? Odds are you will not be flogging the car, so this inexpensive tire should do just fine.

Load range. There used to be a lot of confusion about what loads a tire could handle. This has all been simplified by the load range system. What it says is this:

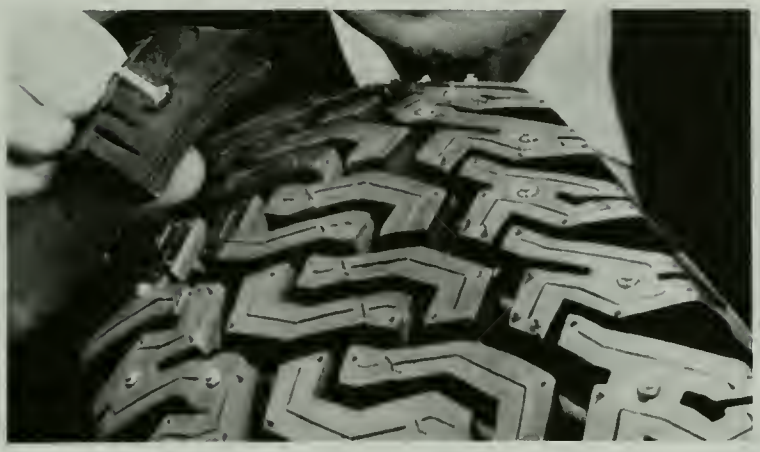
1. All passenger cars with normal loading should be able to use Load Range B tires (this is the rough equivalent of the four-ply tire).
2. All Range B tires of a given size have exactly the same load-carrying capacity at a certain tire pressure.
3. The maximum load-carrying capacity of a tire, which is embossed on the sidewall, is for a tire inflated to 32 psi, the maximum pressure recommended.
4. If a tire doesn't have the load-carrying capacity you want, get a wider tire in Load Range B. If the wider tire won't fit on the car, you will have to go to a higher load range.
5. A tire in a higher load range will only provide greater load-carrying capacity if you run a higher tire pressure. The Load Range B tire has a maximum pressure of 32 psi, Load Range C tires (the rough equivalent of six-ply rating) are rated for load at 36 psi. Note that a Load Range B and Load Range C tire have exactly the same load-carrying capacity at 32 psi or less. The only difference is that you can inflate the C tire to a higher pressure and increase the load-carrying capacity.

To estimate the load-carrying capacity you need, determine the car's curb weight (it may be in the owner's manual or on your car registration). Add the maximum weight of cargo and passengers you expect to carry and divide by four. Only consider a tire that gives you at least a 100-pound safety margin over this figure.

Tube and tubeless. At one time you had a choice between a tube-type and a tubeless tire. Today, virtually all tires sold in the U.S. are tubeless. The tubeless tire loses air more slowly in case of a puncture, so it is considered safer.

Aspect ratio. The aspect ratio of a tire is the ratio of its width to height. This measurement is made on the cross-section, not the whole tire, and if you check, you'll find that the cross-section is wider than it is high. Years ago, tires had an 83 per cent aspect ratio. Today, original equipment tires have 78 per cent ratios—they're wider.

The best and the easiest maintenance for tires is no more than regular pressure checks and adjustments when necessary.



Studded tires improve traction on ice, but they are banned in many states because it is felt they may damage highways.

Optional "wide-oval" tires are 70 and "super wide-ovals" are 60. The wider tire puts a bigger treadprint on the road and carries more load.

Winter tires. If you live in an area where winters are mild and snowfalls are few and relatively light, a set of ordinary radial tires can get you through. Radials' lack of squirm means that the tread pattern stays open to give it some plow through snow.

Where snowfalls are severe, however, you need the specialty tread pattern of the snow tires. The deep treads with wide grooves can really dig into snow for good traction. On dry roads, such tires are noisy, and if you use them in warm weather, run hot because of the deep, specially-shaped tread pattern.

A compromise year-round tire with an assymmetric pattern is a new design. The tread has a basically high-speed highway pattern, plus some of the pattern of a snow tire. How well it works is yet to be proved, for although the tire has been in production for a few years, it has not been in widespread use.

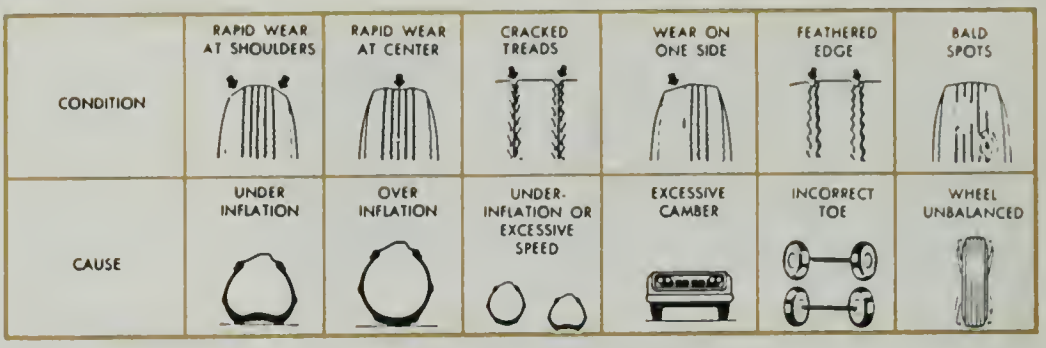
Tire studs are a popular solution for the ice problem. In fact, they're so popular that sales of chains have been sharply declining for the last few years. Studded tires are convenient (no mounting of chains) and can be used at normal road speeds (chains are limited to about 20 mph or so). Studs provide reasonably good ice traction, but if used on dry highways very long, they lose much of their effectiveness, and they are noisy.

Retreads. What about retreaded tires—used carcasses to which new tread rubber has been bonded. Their cost, about half that of a new tire, makes them a tempting buy, but they are only as good as the shop that turns them out. A reputable retreader uses only sound carcasses, and he gives a new tire guarantee.

Retreaded snow tires are a popular purchase, and a sound one. Just remember, however, that you can't mix bias-ply snow tires with radials, or the handling will be disastrous. Retreading of radials is done commonly in Europe (at higher cost than for a bias-ply), but is rare in the United States.

Replacing tires. Whether a pair of new tires should go on the front or rear wheels is almost a tossup. Some experts prefer new tires in front for protection in case of a blowout (a front tire blowout can be harder to handle). However, rear tires wear faster (unless the car has front-wheel-drive).

Get longer wear. Here are some easy hints on how to make your tires last longer. Most important is to check inflation pressures of all tires, including the spare, once a



Common causes of tire wear.

week. Owning a good pressure gauge is a must; service station air pumps are notoriously inaccurate. Remember that even a healthy tire leaks air slowly. Also, each 10-degree drop in temperature causes tire pressure to drop about one pound. Neglect your tires during seasonal temperature changes and you could be running several pounds low.

Underinflation causes increased tread wear along the edges. Also, the tire flexes more and runs hotter, increasing the chances of a failure. Overinflation causes faster tread wear along the center, and makes the tire more vulnerable to high-speed impact damage. Of the two, underinflation is worse.

Since 1966, U.S. car owners' manuals generally have given reliable advice on tire pressures. Before 1966, manufacturers generally recommended overly-low pressures for the sake of riding comfort; better add four extra pounds. Also add three or four pounds for sustained high-speed driving or when carrying a heavy load, but do not exceed the maximum pressure for the load range.

Also note: a few cars require different pressures in front and back tires because of unusual weight distribution or suspension design; failure to observe this differential could cause extremely dangerous and unpredictable handling characteristics. Don't bleed air from tires after a long, hard run. Such pressure buildup is normal—which is why tires should be checked when cold.

Your driving habits also affect tire life. High speeds, jackrabbit starts, panic braking, and hard cornering scrape away rubber fast. Tires wear five times faster at 80 m.p.h. than at 50 m.p.h. High speeds are especially hard on brand new tires To give the plies a chance to seat, limit your speed to 50 m.p.h. for the first 500 miles.

Avoid driving on rough shoulders or the edge of the pavement. Bumping a curb during diagonal parking is a good way to damage the tire carcass and knock your front end out of line. Tire damage may not show up immediately; but it may grow worse as you drive and eventually, perhaps months later, result in a failure. When you park, stop a few inches short of the curb.

The front end should be realigned every 10,000 to 15,000 miles or, if you drive on bad roads, even more often. At the same time have your front wheels balanced with a dynamic balancer (wheels spinning)—never statically (wheels stationary except for hand spinning). What's the difference? Imagine a perfectly symmetrical, perfectly balanced wheel to which two identical weights are added, one at the front, the other exactly half-way around but in back. The wheel would still be balanced statically; while spinning, however, it would develop a side-to-side, wobbling motion.

An out-of-balance wheel can cause un-

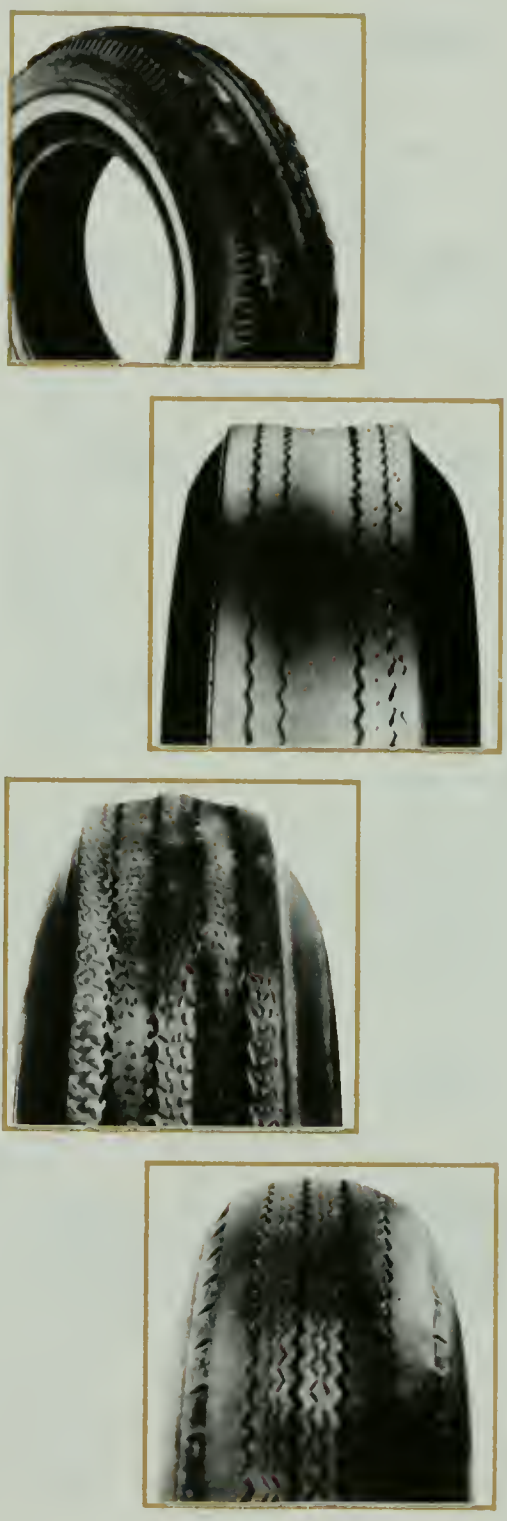
even tire wear and, if it's in front, front-end shimmy and steering wheel vibration. A misaligned front end causes excessive tire scrubbing and, again, uneven and accelerated wear. Other mechanical causes of uneven tire wear include faulty shock absorbers, grabbing brakes, and sagging or broken springs. A word of caution: don't fall for those ads for do-it-yourself wheel-balancing gadgets. Proper balancing requires expensive, sophisticated equipment and special training, and is not a job for amateurs.

The best preventive medicine is to check the condition of your tires often. If you spot uneven tread wear, have your car's running gear checked immediately. Knots, bulges, or cuts also should be checked by an expert. If any grease or oil gets on your tires, wipe it off; petroleum-base materials cause rubber to deteriorate.

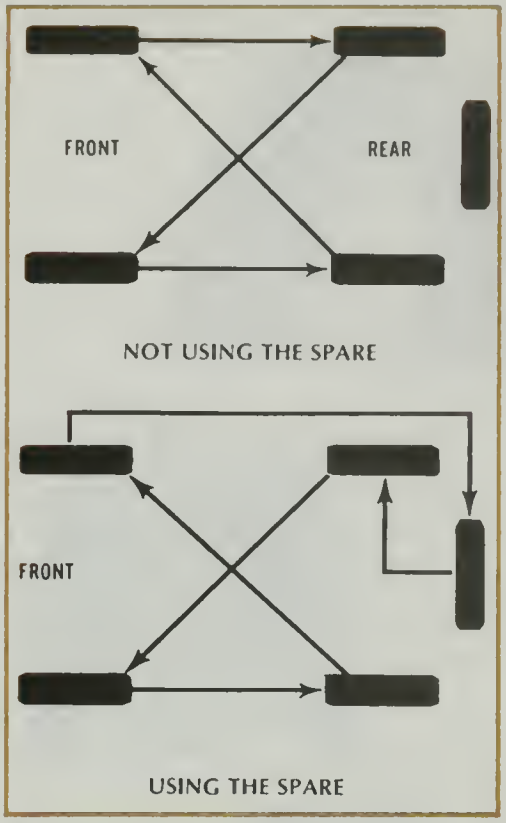
When your car is raised on a lift for servicing, carefully pry out any pebbles, nails, or other foreign matter imbedded in the tread, using needle-nose pliers.

Does it pay to rotate tires? Engineers disagree. Most still recommend switching tires every 5,000 miles or so to equalize wear and allow the spare to see some use. Some say switching is okay providing you don't rotate diagonally, from left to right or vice-versa. Treads develop a directional pattern, they say, and reversing the direction of rotation will increase wear. An Italian tire maker says tires shouldn't be switched at all. Not only is it not worth the cost, he says; it also masks uneven tread wear caused by mechanical defects. What should you do? Here, your guess is as good as anyone's.

No matter how well you take care of your tires, they may occasionally go flat.



➤ *Results of improper care include (top to bottom) suspension neglect, overinflation, underinflation, and extreme cornering.*



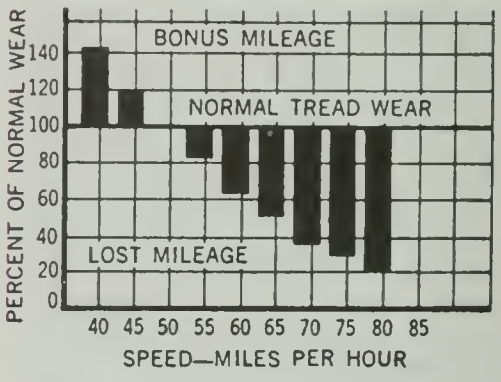
The wisdom of tire rotation is questioned by some automotive engineers. If you do decide to rotate your tires, use either of these typical patterns—one for four wheels and the other for four wheels and the spare. Stick to whichever pattern you pick.

When this happens while you're driving, stop immediately (but don't hit your brakes until your car has slowed considerably, or you may lose control). Driving on a flat tire is the quickest way to ruin it.

If you have tubeless tires, use externally applied plugs or aerosol sealers only in an emergency. Such repairs are temporary, and are not safe at speeds above 50 m.p.h. Have the tire removed from the rim, inspected, and repaired from the inside as soon as possible. Also have it rebalanced.

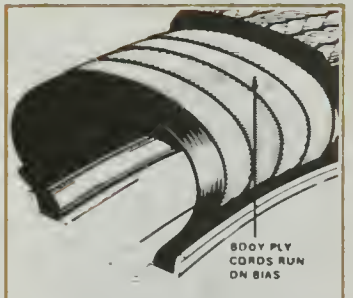
Your tires represent the only contact your car has with the road. Give them the care they deserve. P.W.

See also: DISC BRAKES; DRUM BRAKE SERVICE; HYDRAULICS; SAFETY, BOAT; SHOCK ABSORBERS, AUTO.



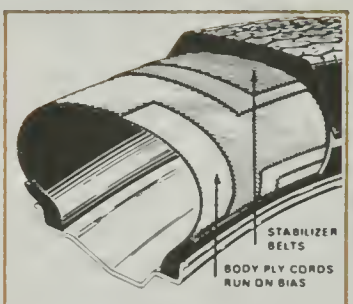
What's Inside a Tire

Bias Ply Tire



Body ply cords run on bias from bead to bead Built with 2 to 4 plies cord angle reversed on each ply Tread is bonded directly to top ply

Belted-Bias



Stabilizer belts are applied directly be neath the tread Body ply cords run on bias similar to conventional construc tion

Radial

Radial ply cords run straight from bead to bead with stabilizer belts applied directly beneath the tread

How to Repair Your Toaster

Changing a damaged cord occasionally and cleaning the crumb tray regularly are usually the most maintenance this simple device will require. If it goes much beyond that, it may be cheaper to replace it rather than make repairs

WITH A LITTLE CARE in cleaning and handling, your toaster should lead a long and useful life. The three major reasons for toaster failure are: dropping, failure to clean out the crumb catcher periodically, and poking out small pieces of toast with a knife or other metal probe.

The two most common complaints about toaster operation are:

1. The toast will not pop up.
2. A heater does not work.

Most toasters operate in much the same way and change very little from year to year. An analysis of one should provide a background that can be applied to many.

Operation. A slice of bread is dropped in the slot and the toaster carriage handle is pressed down until it latches. This action: compresses a spring which later lifts the toast up partially out of the slot; closes a switch which allows electricity to flow through the heating elements; winds the clock mechanism for toasters with clockwork timers, or closes the switch to the bimetal heater for those toasters that have a bimetal or thermal timer. The thermal type timer is most commonly used.

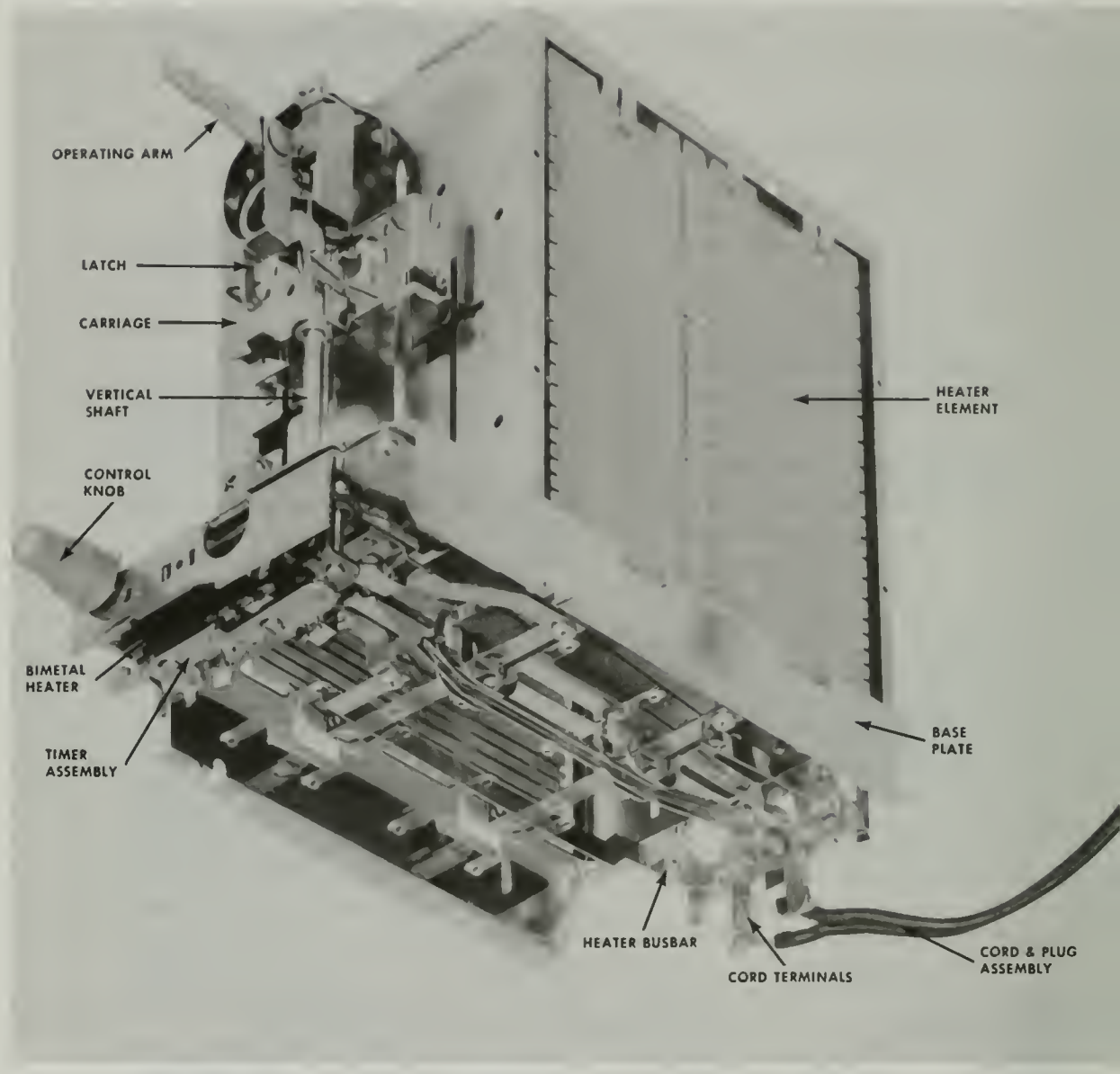
The timer controls the toast color. That is, it controls the length of time the heater elements are on. When the timer turns off it releases the latch and the spring lifts up the carriage and holds it up until the next time it is depressed.

Electrical test and service. When a toaster fails to operate or heat up, the first thing to suspect is lack of power. This may be due to a blown fuse or a defective power cord. Always check the outlet first to make certain power is available. Either plug in a lamp, or use your AC voltmeter. The next item to test is the power cord. Be especially suspicious of this if the operation is erratic, because movement of the cord may cause a broken wire to make contact and the toaster will work for a while. Working the cord back and forth while the toaster is plugged in and turned on will not always show up a defect. The best method is to use an ohmmeter and test the circuit for continuity from point to point.

Most toasters have their heater elements connected in parallel. This type of connection allows one element to heat even if others are burned out. Most often these test points are accessible by removing the bottom of the toaster. The cord can be replaced readily. Fixing any of the other parts usually requires removal of the case.

Mechanical service. To disassemble the toaster, invert it on a soft surface to protect the finish. Remove the screws that hold the

toenailing: see nails



Once the outer shell of the toaster is removed, the working parts are exposed. Usually it is not necessary to remove the shell to change a cord or clean out accumulated crumbs.

undercover in place. Next remove the handles—the plastic parts—at each end. Also remove the operating handle which is often held in place by a screw on its underside.

The timer knob—light-dark control—may have to be removed depending on the size of the hole in the case. Some have a small center screw which has to be removed first. Remove the screws holding the case to the frame.

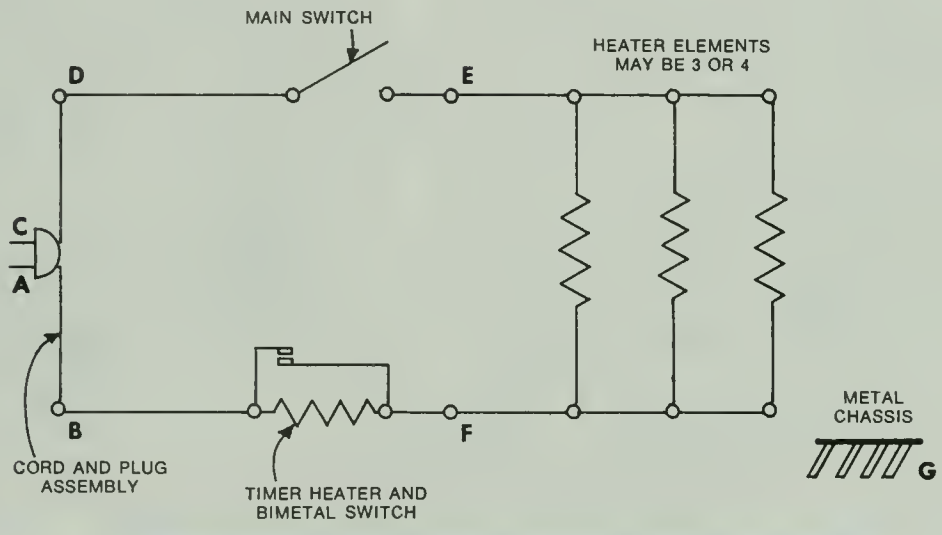
When the case has been completely loosened from the frame, hold the toaster

together and set it in an upright position with the bread slots up. Gently raise the case up and over the operating lever to remove it. Next remove the bread guard wires before they fall out of place and damage a heater element. This should expose the heater elements, carriage mechanism and timer.

The toast carriage guide rod must be clean and straight or the carriage will stick part way, or be slow in lifting. Lighter fluid or dry cleaning fluid can be used to clean the gummy deposit from this rod. Lubricate the rod sparingly with a silicone grease.

Make certain the holding latches and the timer linkages are clean and smooth in operation. Here, too, a good cleanup and careful lubrication can do much to restore normal operation.

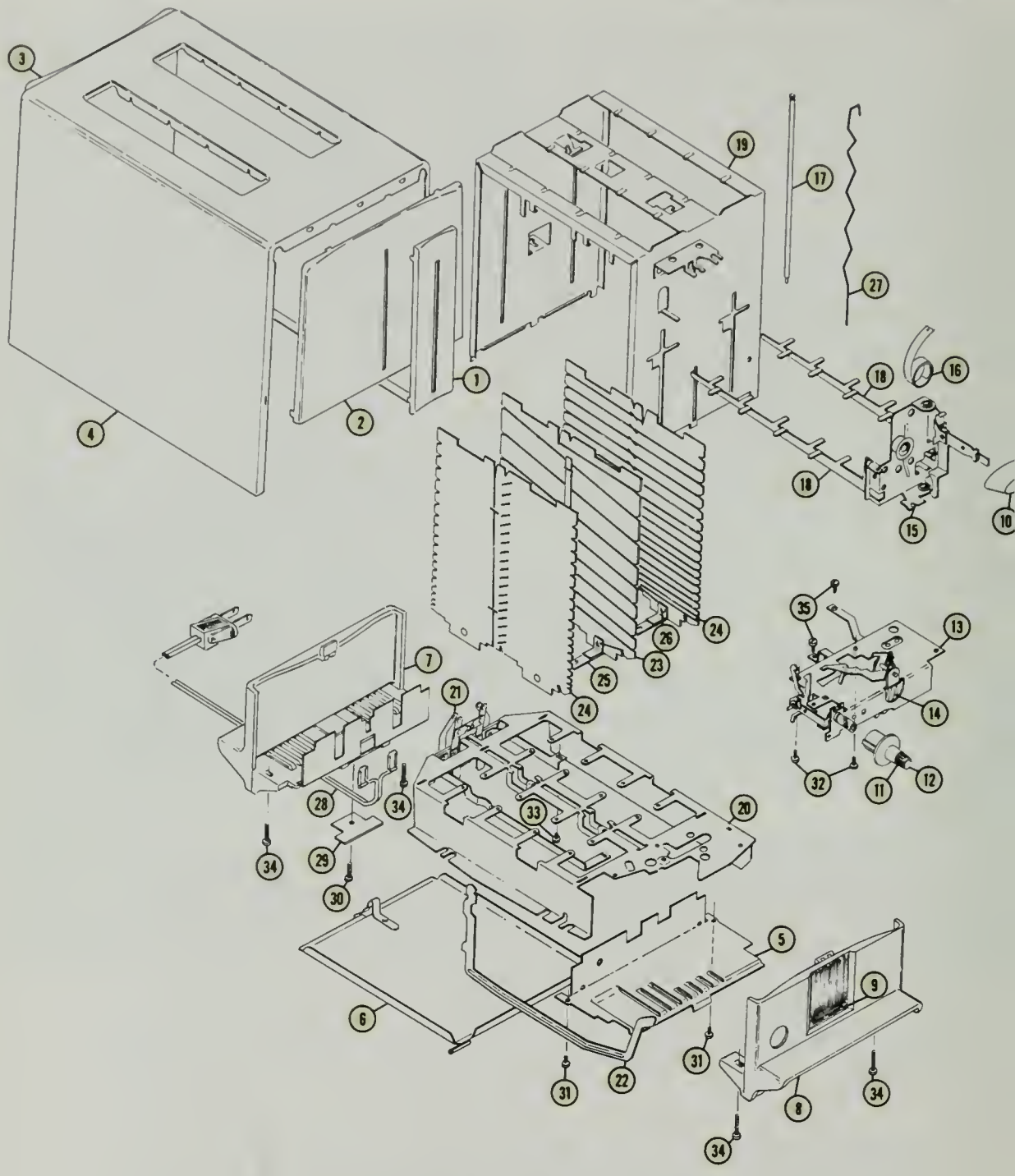
Switch contacts can become pitted and coated, causing them to make poor contact. Careful filing and burnishing of the contacts can add additional life, if the contacts are not too far gone.



OHMMETER ANALYSIS OF CIRCUIT

Points	Correct Ohmmeter Reading	Possible Cause of Incorrect Reading
A to B	0 ohms	∞ = open cord
C to D	0 ohms	∞ = open cord
D to E	0 ohms[1]	∞ or any reading is defective switch
B to F	0 ohms ∞ ohms	Closed timer contacts Open timer heater
E to F	12-15 ohms[2]	Higher = open element Lower = shorted element
A-F to G	∞ ohms	Any reading is short to ground which may shock user

NOTES: [1] With switch closed.
[2] For 1000 to 1200 watt toasters.



▲ *Typical toaster design is shown in the exploded drawing. Use the reference key to identify the parts.*

REF. NO.	PART NAME	QTY.
1	Decor plate	1
2	Case, front	1
3	Case, end	1
4	Case, center	1
5	Front stat. under cover	1
6	Hinged crumb tray assembly	1
7	Rear handle and buffle assembly	1
8	Front handle	1
9	Nameplate decal	1
10	Operating handle	1
11	Control knob	1
12	Insert, control knob	1
13	Timer assembly	1
14	Bimetal arm assembly	1
15	Carriage assembly w/op. lever	1
16	Negator spring	1
17	Vertical shaft	1
18	Bread rack	2
19	Frame and vert. shaft brkt. assembly	1
20	Base plate	1
21	Main switch lever	1
22	Switch bus bar and ins. assembly	1
23	Element, center	1
24	Element, outside	2
25	Bus bar, element connection	1
26	Rivet	As Required
27	Guard wires	As Required
28	Cord and terminal assembly	1
29	Cord retainer cover	1
30	Screw, cord ret. cover	1
31	Screw, 3-48 x 3/16 front stat. to frame	2
32	Screw, 4-40 x 3/16 timer to frame	2
33	Screw, 5-40 x 7/16 bus bar to frame	1
34	Screw, 5-40 x 1/4 plastic handles to frame	4
35	Screw, 3-48 x 1/8 timer to frame	2

Some heater elements are attached to the power bus bars by screws, others by rivets. Those riveted in place should have the rivet drilled out and new elements installed with small screws.

Replace or repair? As a rule the best source of parts is the dealer who sold the toaster or a factory authorized service station. Some metropolitan areas have large well-stocked appliance parts suppliers. These can all be found in the yellow pages of your phone book.

When deciding whether to repair or replace your toaster, consider the cost of a new one against the cost of the part, acquiring it, and installing it. Generally speaking it is economical to replace only the cord or the plastic parts on a toaster and, of course, clean it internally.

In any case get the right part by number for the make and model toaster you are fixing. The accompanying trouble diagnosis chart will show you the area in which to look for specific problems G.M.

See also: APPLIANCE REPAIR; ELECTRICITY; INDIVIDUAL APPLIANCE LISTINGS.

TOASTER TROUBLE-SHOOTING CHART

PROBLEM / POSSIBLE CAUSE	BREAK IN CORD	DEFECTIVE HOLDING CATCH	SWITCH DEFECTIVE	TOAST CARRIAGE BINDS	RELEASE LATCH BINDS	WEAK OR BROKEN SPRING	EXCESSIVE SPRING TENSION	INCORRECT TIMER ADJUSTMENT	DEFECTIVE HEATER ELEMENT	GROUNDED WIRE
DOES NOT HEAT	√	√	√							
TOAST WILL NOT STAY DOWN				√	√					
TOAST WILL NOT POP UP						√				
TOAST LIFTS TOO SLOWLY						√				
TOAST LIFTS TOO RAPIDLY							√			
TOAST TOO LIGHT OR TOO DARK								√		
ONE SIDE UNTOASTED									√	
SHOCKS USER										√

How to Repair a Faulty Flush Tank

Plugging a leak the size of a pinhole can save about 95,000 gallons of water a year

FLUSH TANK DIFFICULTIES are among the most annoying because they are so noisy and persistent. While these troubles can be corrected, easily and inexpensively, they often are neglected because the parts are not visible or readily accessible and the functioning of the mechanism seems a mystery.

Many water closets do not have a shut-off valve and the inexperienced home-owner tries to make repairs with the tank full or with cold water constantly rushing in, which definitely is a handicap.

An understanding of how the tank valves work, and some tips on curing any annoying troubles, will enable you to keep the water closet in good working order.

How it operates. The water closet tank operates by means of two finely balanced mechanisms which function automatically:

1. The flush valve, actuated by a handle on the tank, lifts a stopper plug over the water discharge tube.
2. The inlet valve is controlled by a float which fills the tank and shuts off the water at the correct level.

In addition, there is an overflow tube which bypasses the flush valve and empties any excess water into the bowl if the inlet valve fails to shut off. There also is a refill tube whose purpose is to pour water into the bowl for a period after flushing to maintain a waterlock in the drain trap so that sewer gas cannot come up.

There are differences in the shape and arrangement of these parts in various makes of water closets, but the system essentially is the same.

Flush valve. The handle on the tank trips a lever which pulls up a stopper at the bottom. The stopper ball floats to the top while all the water in the tank rushes out. When the tank is empty, the stopper ball, guided by its lift wire, drops back into position over a seal ring, closing the discharge opening. The weight of water entering the tank through the inlet valve holds the stopper in position.

It is this rubber ball that causes most of the trouble. The ball is attached to a copper stem that rides up and down inside a stem guide, and the stem in turn is connected to the trip lever with a lift wire. The flush ball, round or conical in shape, drops straight down to seat in a brass ring and closes the discharge outlet.

If the water continues to flow, or even to drip, it causes disturbing noises. The inlet valve also is affected and permits water to flow into the tank as well.

First see if pressing down on the stopper ball will end the water flow. If so, find what has prevented it from seating automatically. The chain of search for the trouble starts with the trip lever at the top. See that it is not stuck, thus holding the stopper ball above the valve seat. The lever can sometimes become bent or jammed.

The next point is the lift wire attached to the handle lever. There should be about ¼-inch play in the lift. If it is bent, the distance is shortened and the stopper can't drop all the way down, as it should. Disconnect the lift wire from the stopper stem. See if the stem moves freely up and down in its guide.

Also, and this is important, make sure

the stem guide is directly above the discharge opening. The guide is attached to the overflow pipe and its position can be adjusted by loosening a setscrew at the side with an offset screwdriver.

If all these check out OK, lift out the stopper ball after unscrewing the threaded stem, and see if it is spongy, out of round, or bloated—any of which may prevent complete seating and closure at the valve.

It's a good idea to replace the flush stopper ball at intervals, so do that while it is out. New ones don't cost very much and many can be purchased complete with new stem and wire.

These inspections and adjustments of the stem guide can be made more comfortably and efficiently when the tank is empty. If your water closet does not have a shut-off valve, you can stop the inflow of water by tying the float ball with a string, or placing a short stick under the intake valve bar.

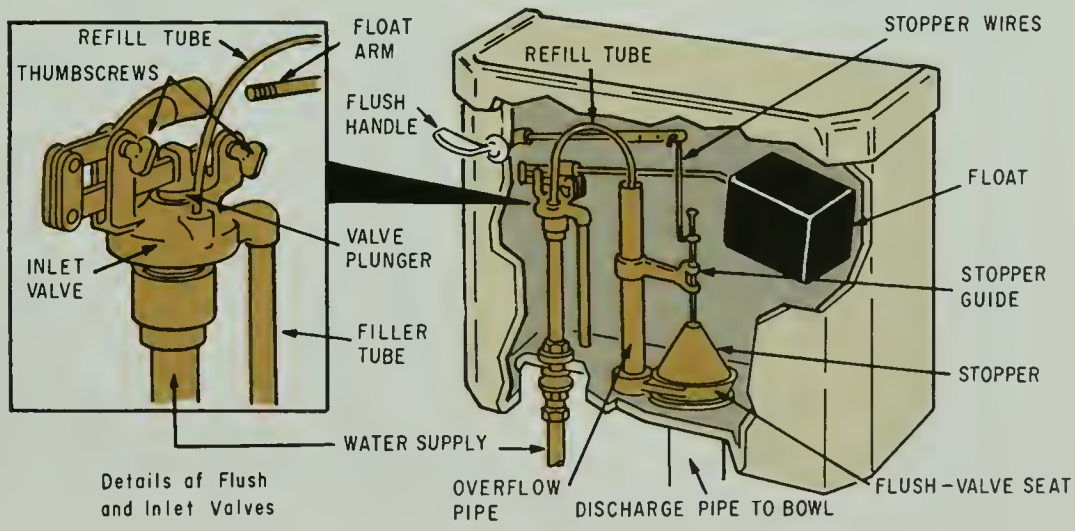
Replacing seal. When the tank is empty examine the brass discharge seal at the bottom into which the stopper fits. See if it is pitted or corroded and whether the surface is rough to the touch. Any damage to the seat would prevent complete sealing of the valve. It is possible to sand it smooth with a piece of emery cloth, but a complete new assembly costs just a few dollars and can be installed quickly in the opening without special tools.

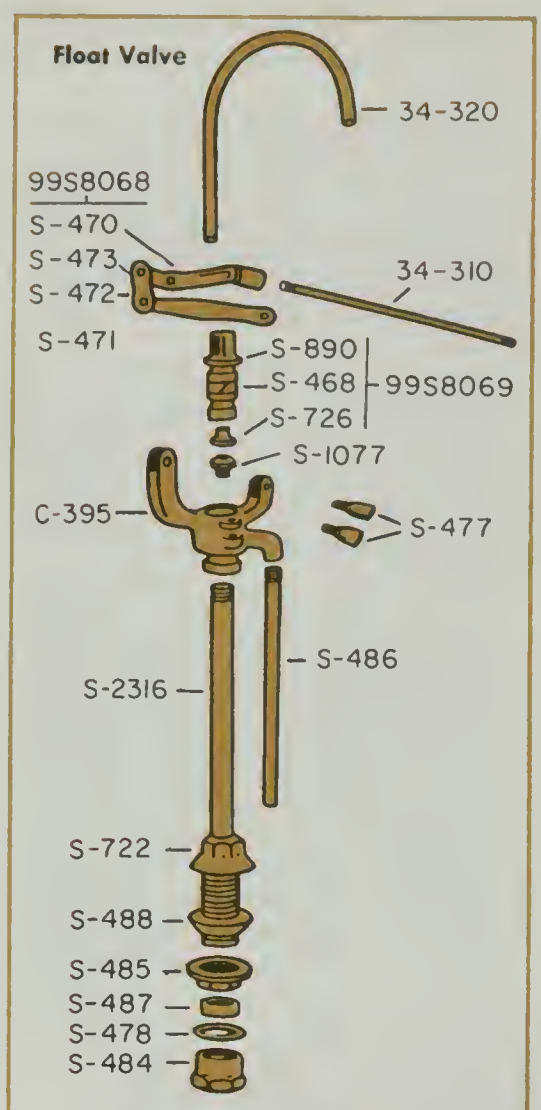
Use a monkey wrench to loosen that nut underneath the discharge pipe to break the connection with the bowl. Remove the short chrome pipe, then turn out the large nut on a threaded pipe extending under the tank. Loosen the flush valve gaskets by working the overflow pipe from side to side until the assembly comes free.

Remove the flush valve parts, unless you have purchased the complete assembly with overflow pipe and stem guide. The new unit comes complete with gaskets and washers, and is installed through the tank with just enough tightening of the bottom nut for a watertight fit.

Special devices. Many devices have been developed to overcome the persistent problems with the flush valve stopper. These still operate on the same principle (no practical substitute has yet been found for the hollow stopper ball) but aim primarily to keep the stopper always in line with the discharge opening seat.

A leading manufacturer of faucet washers and valve seals offers one product which depends on a group of prongs inside the discharge opening to line up the ball stopper.





99S8068	Lever assembly
99S8069	Plunger assembly
34-320	Refill tube
34-310	Float rod
S-477	Thumbscrew
S-1077	Nylon renewable seat
S-2316	Supply tube
S-486	Hush tube
S-722	Shank
S-488	Bevel washer
S-485	Lock nut
S-484	Coupling nut
S-478	Coupling washer
S-487	Slip joint washer
C-395	Body

Another company offers a mechanism which depends on an exterior plastic guide tube to keep the stopper in line.

There are many others, and each will solve the trouble temporarily. Until the perfect solution is invented, keep your flush tank valves in good condition and correct adjustment, and the performance will be quite satisfactory.

Inlet valve. When water constantly drips down through the overflow pipe, the trouble is with the inlet valve and usually is due to improper functioning of the float ball. This may be the result of pinholes in the copper.

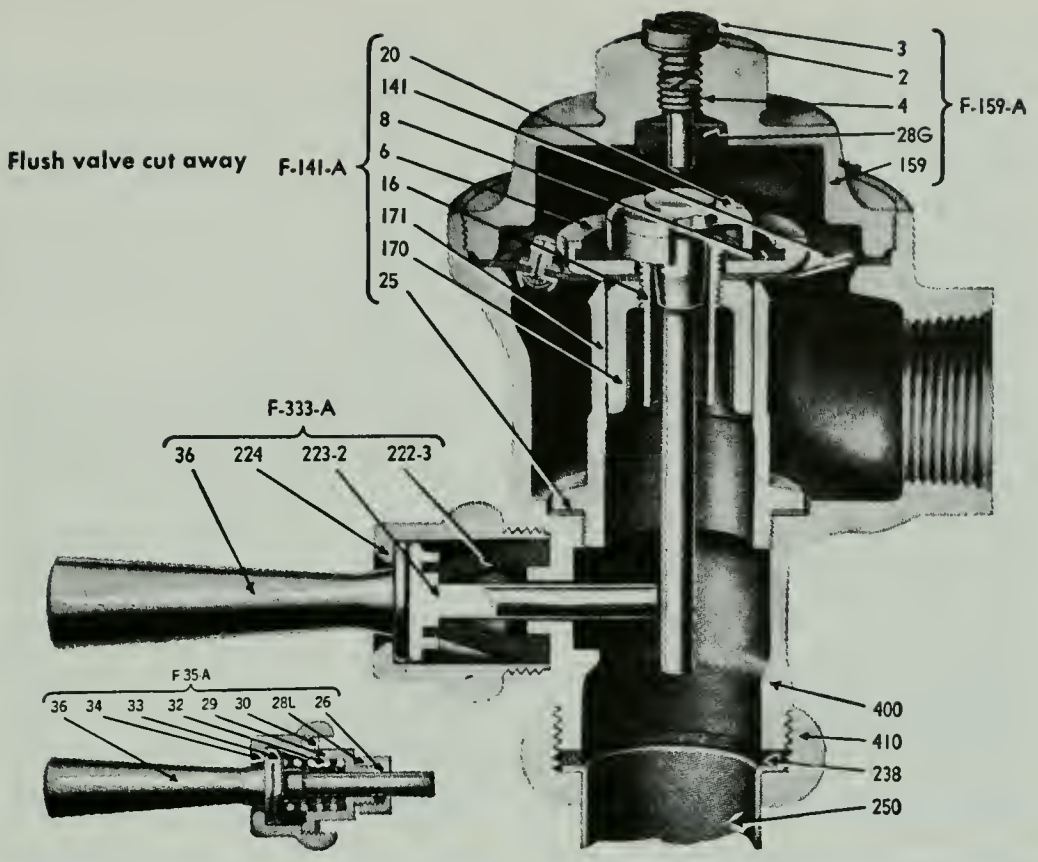
You can test the float by unscrewing it from the rod and shaking it to see if it has water inside. Soldering is not worthwhile, as a new foam rubber or copper float costs very little and is installed in just a few minutes without tools. Make sure the float is not hitting the side of the tank and the float rod is bent at the correct angle.

The float arm should be adjusted to maintain water level in the tank at about an inch below the top of the overflow tube.

The intake valve may require occasional replacement of its washer. To do this, after emptying the tank as described above, turn out the thumbscrews that act as shafts for the valve levers. Then lift out the piston assembly and slide it off the lever. The washer is at the bottom of the stem, and is usually held with a brass screw or a locking ring. If the thumbscrew pins or washer ring are corroded, replace them with new ones.

Another cause of ball cock leak is the split leather packing ring on the piston plunger at the top of the assembly. The ring slides off the groove for replacement.

A leak at the discharge tube into the water closet bowl is due to a worn spud washer. To replace, uncouple the chrome slip nuts, slide the tube out of the brass spud at the back of the bowl, unscrew the jam nut and pull the spud clear. Replace the washer with one of the correct size, and reassemble.



REF. NO.	PARTIAL ASSEMBLIES
F-141-A	Diaphragm operating assembly, complete
F-159-A	Cover assembly, complete
F-333-A	Handle assembly
F-35-A	Spring loaded handle

REF. NO.	INDIVIDUAL REPAIR PARTS
F2	Washer for cover screw
F3	Cover screw
F4	Regulating screw
F6	Auxiliary valve seat holder
F8	Auxiliary valve rubber seat
F16	Diaphragm bushing
F20	Bronze auxiliary valve assembly
F25	Fiber main valve seat washer
F26	Packing for handle packing nut
F28G	Packing for cover
F28L	Packing nut for handle
F29	Spring housing
F30	Fiber washer
F32	Spring for handle
F33	Operating stem
F34	Handle nut
F36	Metal handle
F141C	Diaphragm with by-pass (for closet valve)
F141U	Diaphragm with by-pass (for urinal valve)
F159	Cover assembly, complete
F170C	Seat guide (for closet valve)
F170U	Seat guide (for urinal valve)
F171	Main valve bronze seat
F223-2	Operating stem
F222-3	Rubber flexer
F224	Handle nut
F238	Fiber coupling washer
F250	$1\frac{1}{2}$-inch chrome plated tailpiece with collar
F400	Valve body only
F410	$1\frac{1}{2}$ x $1\frac{1}{2}$-inch coupling nut

Condensation on tank. With a tank full of fresh cold water, it is to be expected that the room humidity will cause condensation on the tank. This unsightly condition can be extremely annoying because of constant dripping of water on the floor causing mildew of linens in the room, and is generally untidy.

Plastic drip pans can be purchased to fit under the tank for catching the condensate. A more expensive but practical correction is a tempering valve which feeds enough hot water into the tank to maintain room temperature.

Flushometers. Flush valves are coming into wider use in homes, wherever there is sufficient water pressure, and the pipe sys-

tem is large enough for an ample flow of water.

These valves are highly efficient and can keep operating for long periods without any malfunction. But when they do go off the beam, they can play havoc with any well-ordered home. Water gushes forth at an alarming rate, hour after hour, and jiggling of the level handle just seems to call for more of the same.

Of course, the shut-off valve can be closed, but most members of the household don't even know about that, or where it is. Other difficulties with these valves are that they deliver either insufficient or excessive flow of water at each flushing, or water drips from the handle stem.

Inside the bell-like housing at the top there are two water chambers, separated by a leather diaphragm. A dish relief valve is in the center of the diaphragm. A slight touch of the level handle in any direction pushes in the plunger and tilts the relief valve, releasing the pressure in the upper chamber. The water supply pressure then pushes up the entire diaphragm and valve; the gush of water flushes the bowl.

Some water, however, seeps through the bypass and gradually fills the upper chamber to again close the valve.

Trouble-shooting. Here are the various troubles that might develop:

1. Water continues to run. Bypass screen may be clogged with grit or diaphragm badly worn. Clean bypass with fine wire. Sometimes the valve fails to close fully due to sediment on the rubber washer which serves as valve seat. Replace diaphragm or cup washer.
2. Water drips from release handle. Replace with handle coupling washer.
3. Water flow is inadequate or too long. Turn regulating screw at top of valve chamber to obtain best timing of valve.
4. Leak at tailpiece coupling under valve. This may be caused by deterioration of rubber vacuum breaker. Replace with new one if necessary. Do not seal off the air ports at the side, as they are necessary for proper functioning of the vacuum breaker to prevent siphonage.

To install the new valve washers, close the shutoff valve at the water inlet side, by turning clockwise. Use adjustable wrench to turn off valve cap. The valve plunger and diaphragm may now be lifted out.

Use a spanner wrench to remove the disk ring that holds the valve seat washer. Clean the disk carefully with a brush—do not scrape with knife or screwdriver. The diaphragm now can also be taken out and replaced with a new one of the same size.

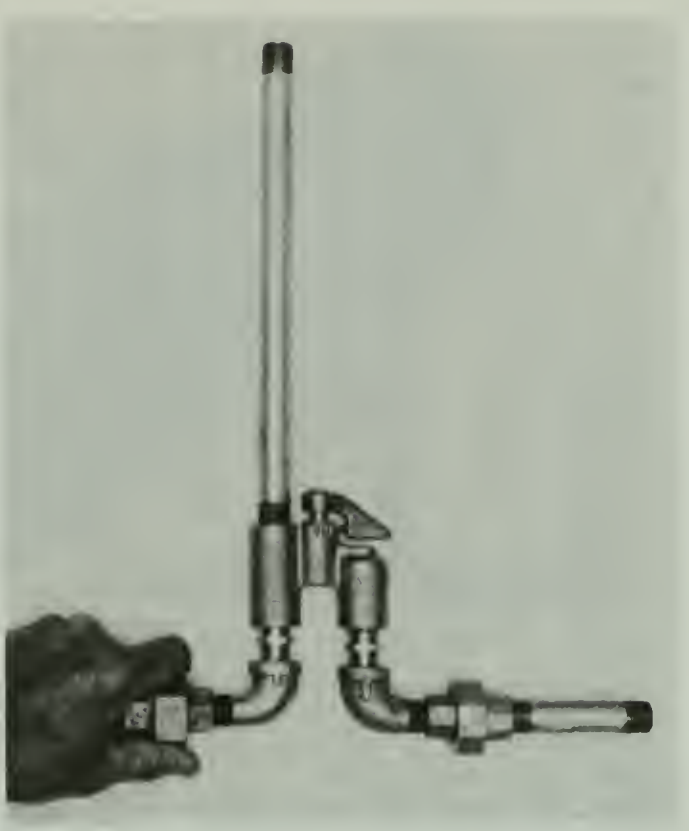
When replacing the diaphragm, be sure that it is pushed down to bottom of thread and rests flat on the seat, to prevent wrinkling and curling. Don't use white lead. Restore relief valve over diaphragm and screw the housing cover back tightly.

The plunger washer may be replaced quickly by loosening the coupling, so that entire plunger arm may be pulled out. The small coupling washer is near the end and can be pushed out. Put on new handle packing washer before replacing the plunger.

If there is a vacuum breaker in the flush valve, the tailpiece pipe will have an air vent near the top, which will be hidden by the cowl nut. If there is leakage at this point, drop the cowl nut to loosen the pipe and take out the rubber sleeve and brass insert. If the rubber shows any signs of distortion or damage, replace with a new one.

If there is not sufficient flow at the flush valve, check the water pressure in the house. Any drop at the street main below the rating required for your house will affect the flow at the bowl. Your plumber or water department can easily check this with a gauge if you suspect a sharp drop in main pressure.

See also: PLUMBING.



Assembled mixing valve adds a regulated amount of hot water to the cold water supply line to the toilet tank. Cold water enters at left. The hot water enters the device at right and passes through a control valve before entering the cold water stream. Vertical pipe on top would lead to the toilet tank. Both the hot and cold sides of the device have check valves that prevent hot water from entering cold water line and vice versa.

How to Stop Toilet Tank Sweating

Beads of moisture dripping from a toilet tank can be a nuisance, but the problem can be eliminated with the installation of a simple valve

TOILET TANK SWEATING can be a nuisance—especially if it is severe or continuous—but it can be prevented by eliminating the cause.

Toilet tanks sweat when warm moist air hits the cold surface of the tank. The moisture condenses, leaving beads of water on the tank to drip to the floor.

The way to solve the problem is to keep the toilet tank relatively warm, near room temperature. Then the moisture won't condense and the surface will remain dry.

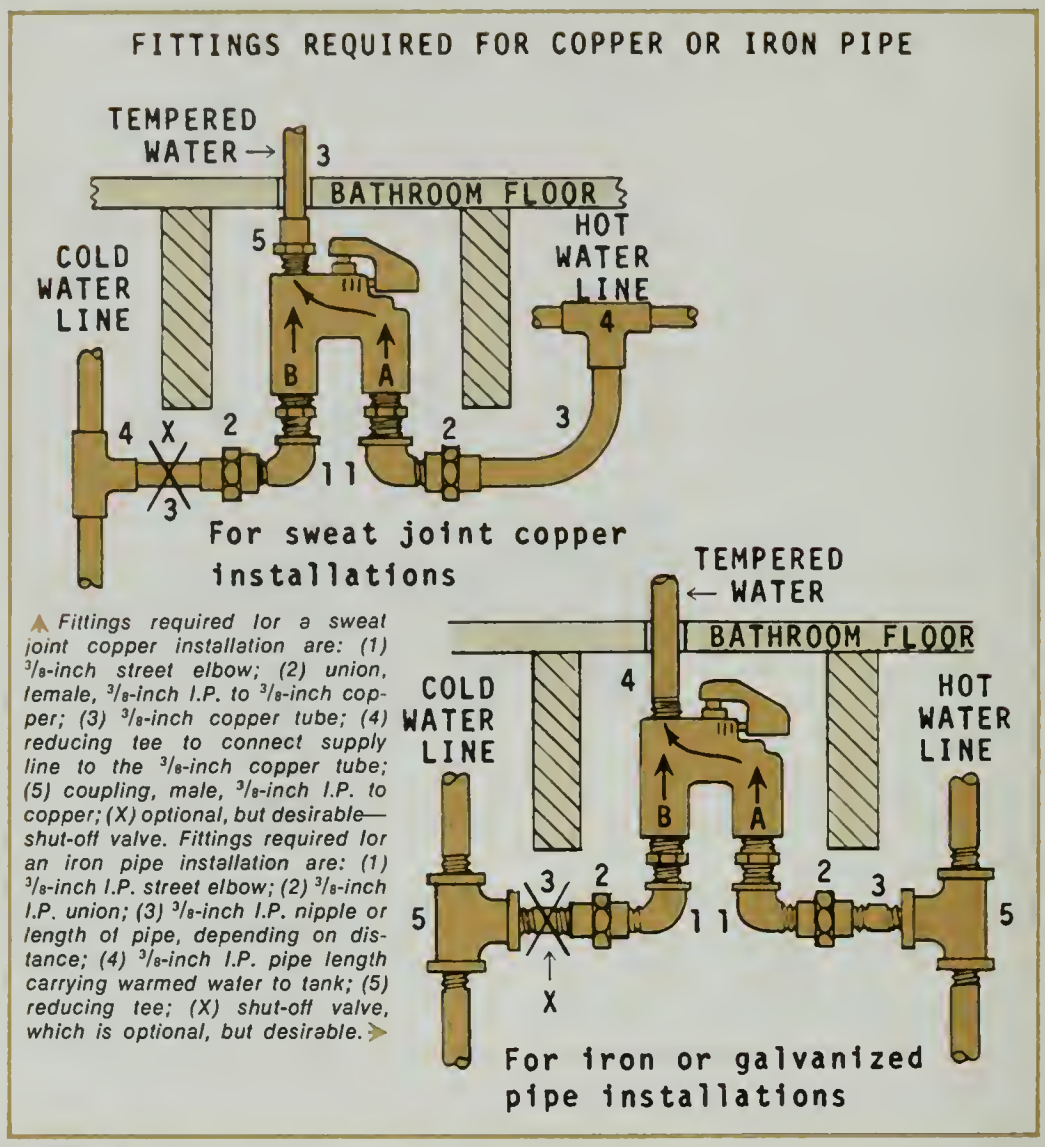
You can keep the tank warm by installing a relatively inexpensive valve that will add a little hot water to the cold water used to fill the tank after the toilet is flushed.

The valve, called a Temperator, is available at hardware and plumbing supply stores and comes with complete instructions.

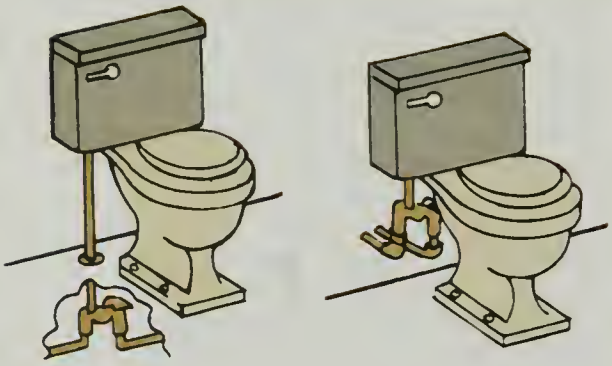
If you are handy with plumbing, you can do it yourself. Or you can call in a professional. For a plumber it's a quick job.

The valve is installed between joists, preferably in the basement. It has one outlet and two intakes. One intake is connected to the cold water supply. The other is connected to the hot water supply. The outlet is connected to the pipe that leads to the toilet tank.

Between the two intakes there is an adjustment that regulates the amount of hot

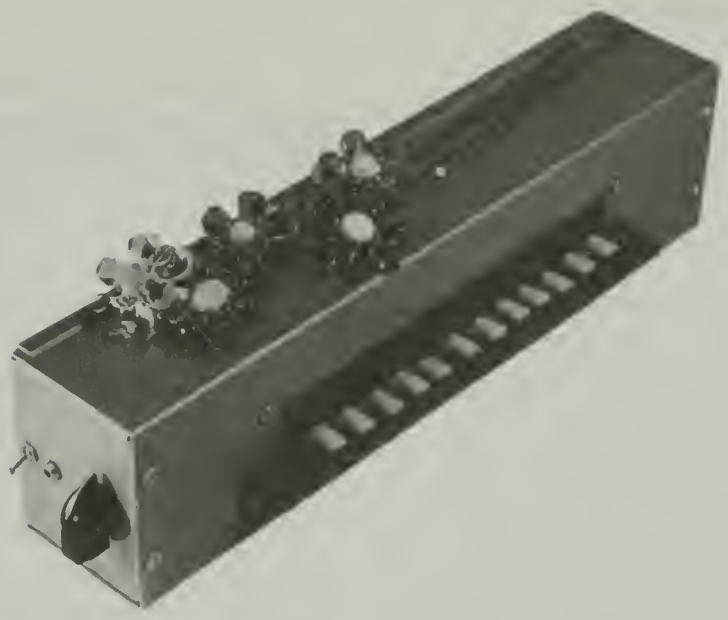


▲ *Fittings required for a sweat joint copper installation are: (1) 3/8-inch street elbow; (2) union, female, 3/8-inch I.P. to 3/8-inch copper; (3) 3/8-inch copper tube; (4) reducing tee to connect supply line to the 3/8-inch copper tube; (5) coupling, male, 3/8-inch I.P. to copper; (X) optional, but desirable—shut-off valve. Fittings required for an iron pipe installation are: (1) 3/8-inch I.P. street elbow; (2) 3/8-inch I.P. union; (3) 3/8-inch I.P. nipple or length of pipe, depending on distance; (4) 3/8-inch I.P. pipe length carrying warmed water to tank; (5) reducing tee; (X) shut-off valve, which is optional, but desirable.* ➤



water entering the line when the tank is filled wtih cold water. To adjust the valve, start with the control nearly closed and observe the toilet tank. Increase the amount of hot water in gradual stages until the tank no longer sweats. The hot water regulator can also be closed completely, an economical feature for areas where sweating is seasonal.

See also: PLUMBING.



Build a Tone and Chord Generator

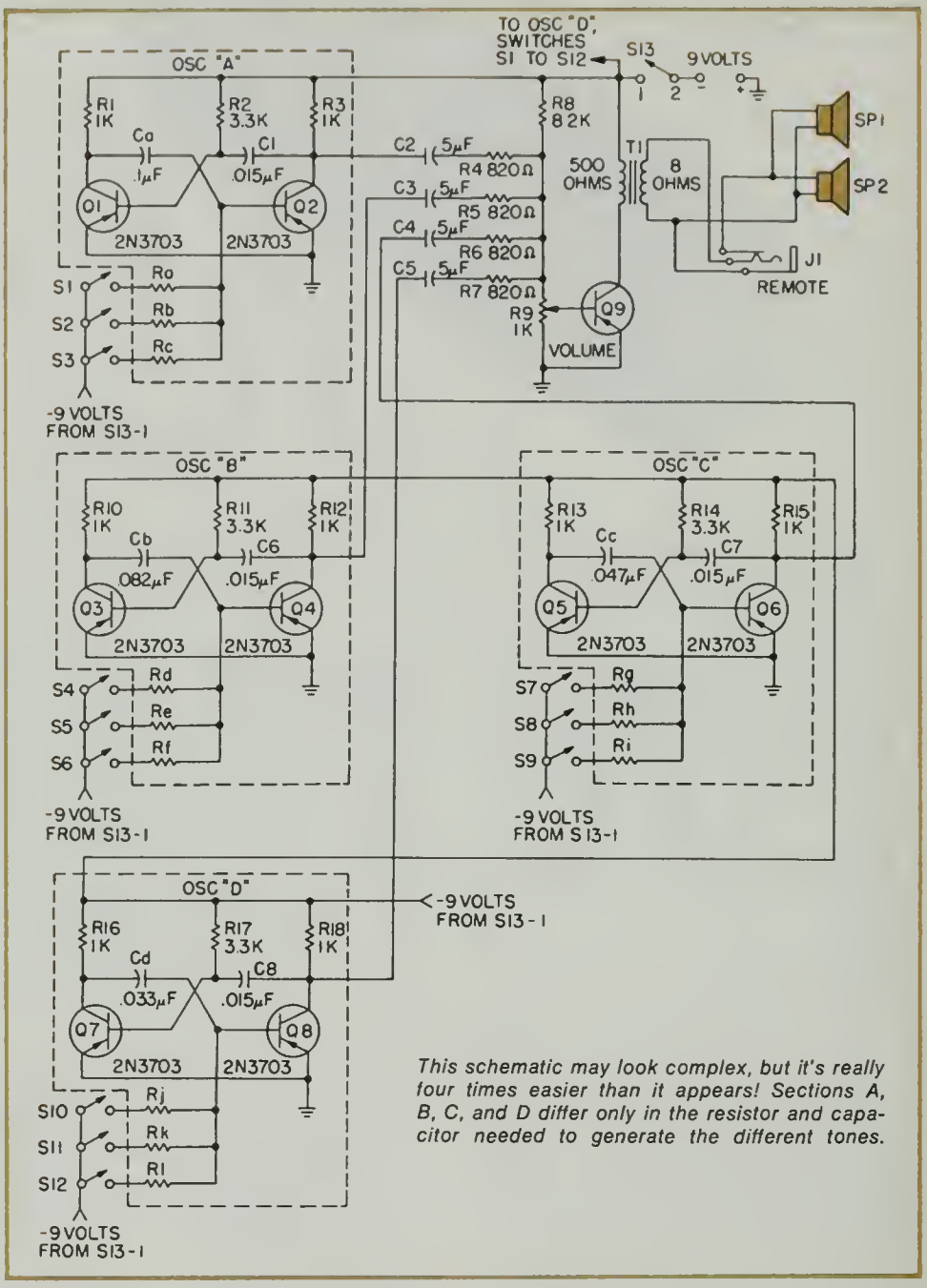
You can build one to play music based on a scale established by stock resistor values, or with additional parts, you can build it to play the traditional scale

TO ALL BUT THE SOPHISTICATED ear, tones generated by a square wave source can sound similar to those produced by a sine wave oscillator. The multivibrator music box uses 12 notes; unusual chords result from combinations of these notes. The box is portable, has an earphone jack, and can be played through your radio so that you can accompany your favorite music. Two speakers connected in parallel give plenty of volume when you want it.

From resistors to notes. Four transistorized multivibrators are used, each is capable of running at one of three frequencies by changing the base resistors. Depressing one of the 12 keys connects battery voltage to a different base resistor.

Outputs of the four multivibrators are summed in 680-ohm resistors and thereafter fed to an amplifier. The amplifier output, the summed result of four multivibrators, is then used to drive the output speakers—assuming that the output jack has not had either a headset or a radio-phono input plugged in.

Each multivibrator is identical in design to the others except for the frequency forming circuits in one leg of each. The frequencies go higher, piano fashion, from left to right. It establishes a sort of face value between piano and organ. However, here the similarity stops. Shying away from expensive precision values to establish exact note jumps (intervals), standard *RETMA* value resistors are used. The Frequency Chart indicates the switch, its approximate frequency, and also its relation to keys on a piano. The range of the music box is roughly that of a piccolo. Frequencies will, therefore, deviate from pure Steinway, so that those fortunates with perfect pitch may be somewhat pained by the box's output. (For perfectionists you might add a series of adjustable potentiometers and reduce the



This schematic may look complex, but it's really four times easier than it appears! Sections A, B, C, and D differ only in the resistor and capacitor needed to generate the different tones.

present "base" resistors by about 20 percent of their value. Select a series potentiometer with a resistance value about half the value of its associated base (Ra to R1) resistor. Then, each frequency is tunable within limits.

Building hints. The entire circuit is mounted on a vectorboard. The transistor

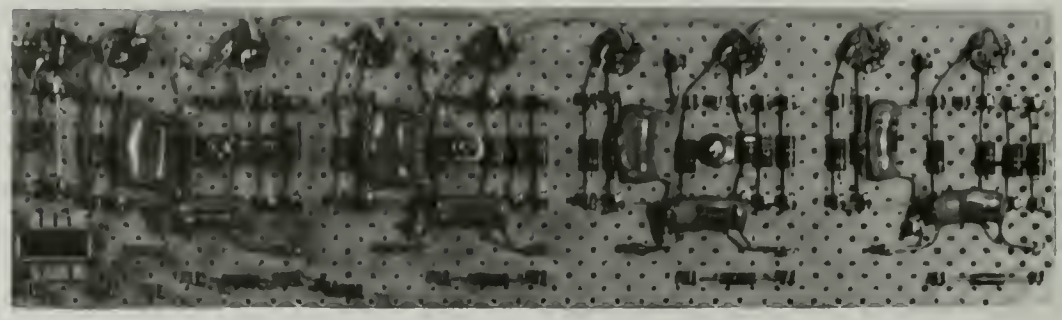
PARTS LIST	
Ca	0.1 μF Mylar capacitor, 12 VDC or better
Cb	0.082 μF Mylar capacitor, 12 VDC or better
Cc	0.047 μF Mylar capacitor, 12 VDC or better
Cd	0.033 μF Mylar capacitor, 12 VDC or better
C1, C6, C7, C8	0.015 μF Mylar capacitor, 12 VDC or better
C2 to C5	5 μF non-polarized electrolytic or tantalum capacitor, 15-50 VDC
J1	Jack with normally closed switch, any style
Q1 to Q8	2N3703, HEP-57, RS 276-2024, etc.
Q9	2N428, HEP-2, RS 276-2004, etc.
Ra	120,000-ohm, 1/4-watt resistor
Rb	100,000-ohm, 1/4-watt resistor
Rc	82,000-ohm, 1/4-watt resistor
Rd	68,000-ohm, 1/4-watt resistor
Re	56,000-ohm, 1/4-watt resistor
Rf	47,000-ohm, 1/4-watt resistor
Rg	39,000-ohm, 1/4-watt resistor
Rh	33,000-ohm, 1/4-watt resistor
Ri	27,000-ohm, 1/4-watt resistor
Rj	22,000-ohm, 1/4-watt resistor
Rk	18,000-ohm, 1/4-watt resistor
Rl	15,000-ohm, 1/4-watt resistor
R1	1000-ohm, 1/4-watt resistor
R3	1000-ohm, 1/4-watt resistor
R10	1000-ohm, 1/4-watt resistor
R12	1000-ohm, 1/4-watt resistor
R13	1000-ohm, 1/4-watt resistor
R15	1000-ohm, 1/4-watt resistor
R16	1000-ohm, 1/4-watt resistor
R18	1000-ohm, 1/4-watt resistor
R2	3300-ohm, 1/4-watt resistor
R11	3300-ohm, 1/4-watt resistor
R14	3300-ohm, 1/4-watt resistor
R17	3300-ohm, 1/4-watt resistor
R4 to R7	820-ohm, 1/4-watt resistor
R8	8200-ohm, 1/4-watt resistor
R9	1000-ohm, audio taper potentiometer
S1 to S12	SPST microswitch, lever type (see text)
S13	SPST toggle or slide switch (ON—OFF)
T1	Miniature output transformer, 500 ohms to 8 ohms (Lafayette 33-85572 or equivalent)
Misc.	6 AA batteries in series.

sockets and interconnector wires are installed first, leaving actual components until last. Locate parts as shown unless you can find a better way. Location is not that critical. When the circuit board is completed, mount the chassis components.

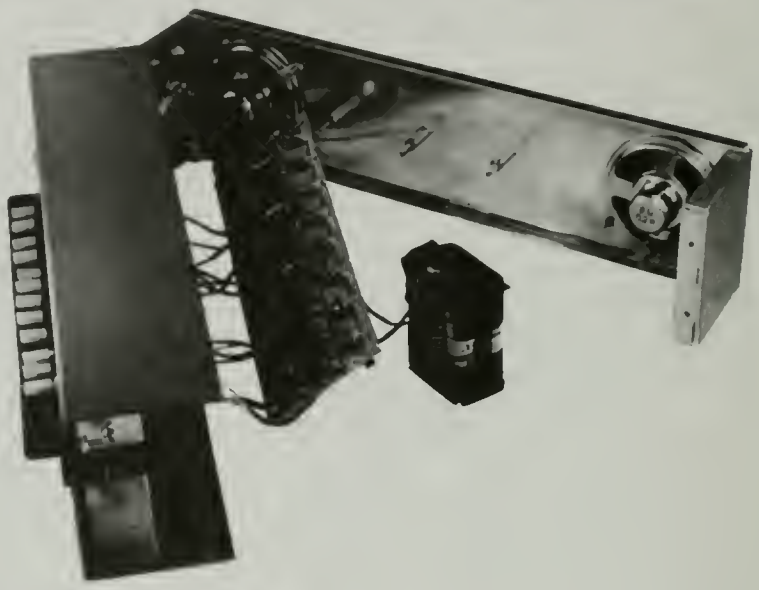
Speakers, volume control, power switch and output jack are mounted at one end, preferably near the output transistor. The entire music box is housed in a 13 x 13 x 2⅝-inch enclosure and can be painted to suit your own musical-color mix. Keys are any style of lever microswitch. Often these switches can be picked up at the local electronics store in the bargain section for a fraction of the manufactured cost. Spacers are used between each switch for rigidity. Use copper tubing to cut spacers because it is easy. You may purchase precut spacers or make your own as the mood suits you. The switch assembly is separate and is mounted on the opposite wall from the

FREQUENCY CHART

Key Switch Number	Approximate Frequency (Hertz)	Approximate Musical Note	Resistor Value (10%)
S1	625	E	120K
S2	716	F	100K
S3	845	A	82K
S4	1030	C	68K
S5	1220	E	56K
S6	1561	G	47K
S7	1750	A	39K
S8	2080	C	33K
S9	2500	E	27K
S10	3030	G	22K
S11	3450	A	18K
S12	4150	C	15K

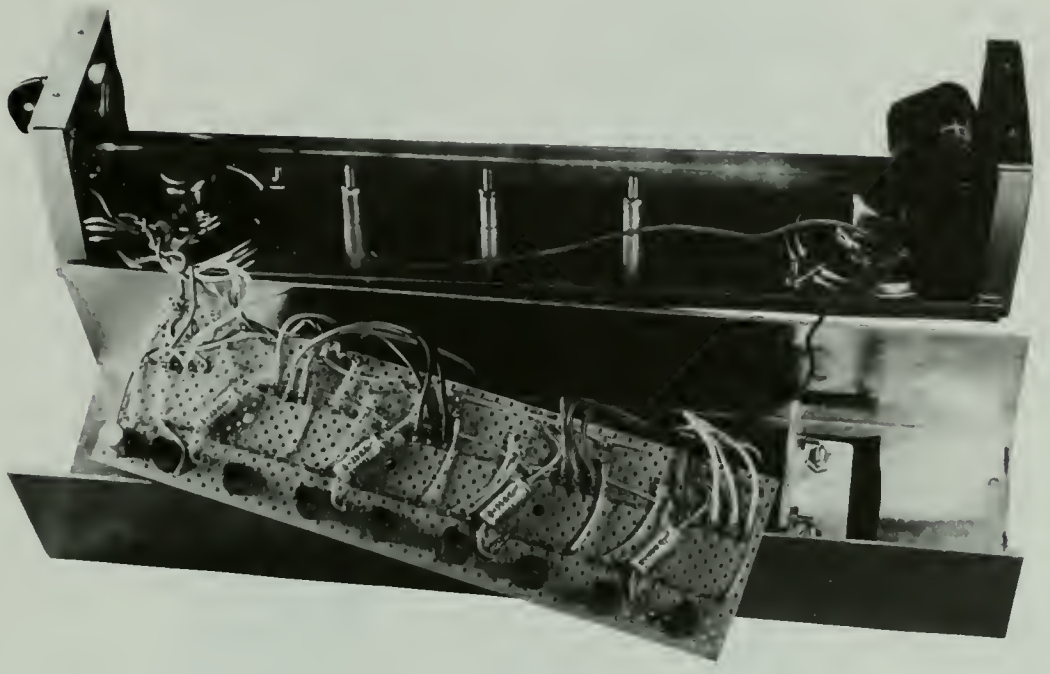


▲ *Top of vectorboard circuit clearly shows circuit zones for oscillator A through D. First a pair of transistor sockets (two round objects in lower left of photo) and grouped components above them form an oscillator zone A. You can see pattern repeated for remaining three oscillators. Transformer T1 (upper right of board) and transistor socket for Q9 below it round out the board with an audio amplifier output power stage.*



➤ *Use any SPST spring return switch you have available. Often surplus units can be used that can be purchased quite inexpensively.*

◄ *This project is based on the use of standard resistors. The 1/2-watt 10 percent tolerance type is usually the least expensive, but you can use any closer tolerance or 1/4-watters. Exact pitch requires pots; see text.*



Underside of vectorboard shows a keyboard tiepoint, Q1 to Q9 transistors and capacitors C2 thru C5.

speaker deck with a rectangular opening cut in the box to project the lever switch arms through. This method of mounting the switches places them at about the right spacing for fingers.

Be careful to connect all wiring to the lower edge of the circuit board. This will allow the board to swing out and away for underside servicing and test. Mounting screws or nuts should stand clear of any component.

The battery pack is wired to the power switch S1, then onto the circuit board. It's a good idea to check your wiring prior to installing any transistors. You can do this by measuring the voltage between the collector of any transistor and its emitter. You should have 9 volts with all transistors out and no key depressed.

The keys are assembled to a subchassis which is then mounted to the main chassis behind a curtain of black felt. Mount a piece of angle aluminum below the keys if you wish to limit the travel or downward motion of the keys.

Operation. Just as each of the 12 separate keys produces an individual note, so will combinations of keys produce chord notes. Try to use standard resistor values. The result is that the frequency difference between notes does not match piano notes. Instead, a new kind of music called stock value music is generated. This music deviates from the old tonal scale and adheres to a new scale named for the resistors used to generate the music. They can, of course, be purchased from any electronics parts house as opposed to expensive precision valued resistors that would be necessary to produce the old classical scale values all those other musicians insist on using. Don't be disappointed though because you're in for a treat. Stock value music has much to offer for the growing number of fans interested in electronic music. J.R.S.

See also: ELECTRONICS.

Keep Your Tools Ready with This Handy Carrier

Keep your tools in this caddy and they'll always be ready to go, cutting the time it takes to get a job done by as much as half

HALF THE EFFORT required in doing any fixing job around the house is that of finding the tools you need and toting them to where you're going to use them. When you keep the commonly used tools in a handy carrying case, all ready to go, it saves steps as well as considerable time because there's no going back and forth, up and down the stairs to the basement workshop, to bring along something you forgot to take in the first place—something you must have for a job.

This tool caddy was designed to provide a practical answer to this problem. Easy to carry by the comfortable long handle of one inch dowel, and with a convenient height that cancels out any need to stoop, the carrier actually stores the assortment of tools with utmost visibility so that you always know just what's there. The tools are hung on special attachment hangers on both sides of a pegboard panel, or rather a double pair of panels which are separated sufficiently to allow space for storing a carpenter's hand saw between them. The

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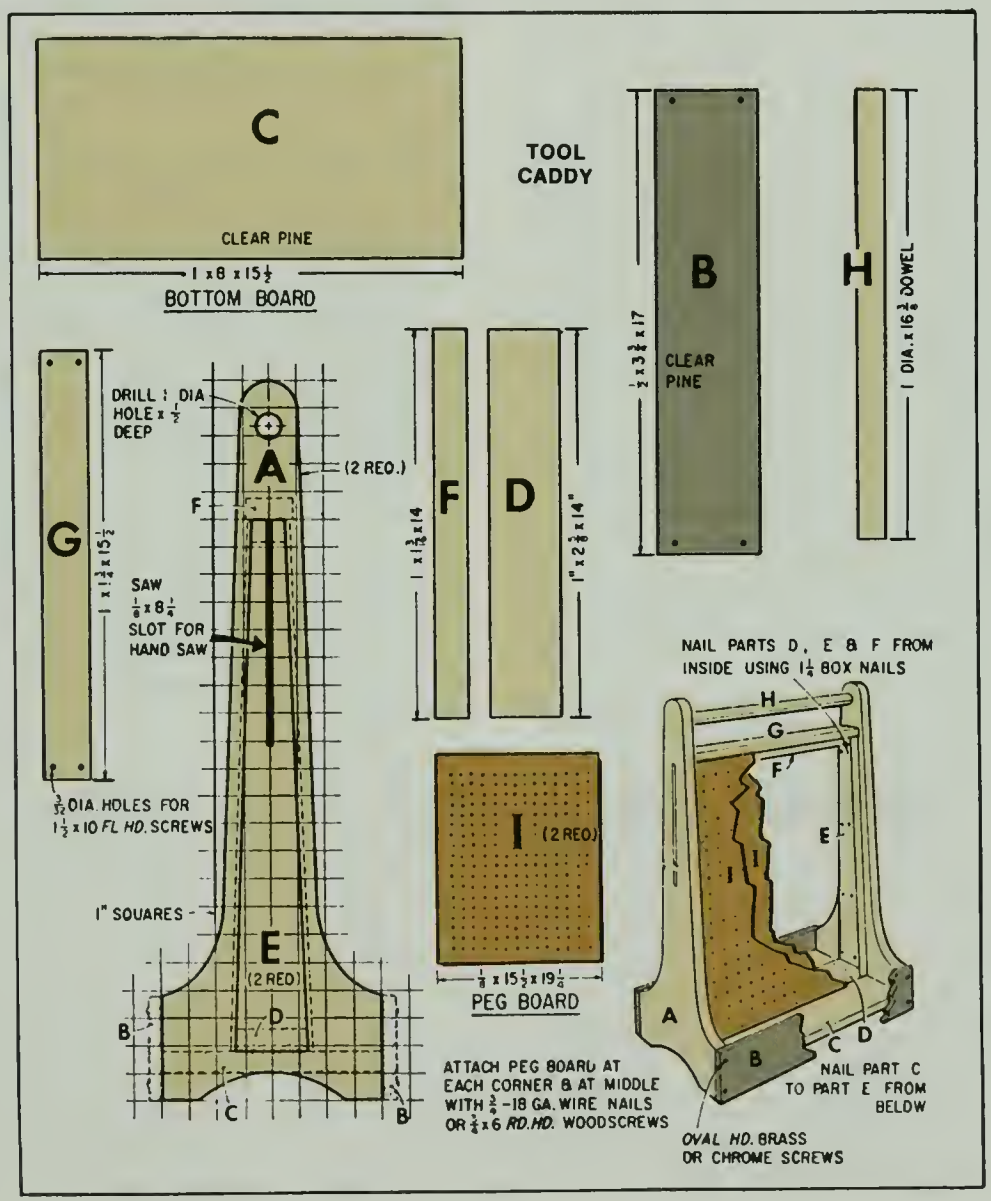
caddy has a compartment at each side to hold jars for screws, nails, bolts, and other small items, as well as an electric drill or saber saw.

Remember that all stated dimensions refer to the basic lumber stock sizes: thus one inch pine would actually be about ¾-inch thick. But the other given dimensions are actual widths and lengths.

Start the project by cutting the two sides (part A) from the 10-inch wide pine board, following an outline traced from a kraft paper pattern which has been ruled for the needed 1 inch squares. Drill a 1 inch diameter hole in each of the sides, but only to a depth of ½-inch to serve as sockets for the dowel handle.

Cut two E parts, as shown in the sketch.


TOOL CADDY
C
CLEAR PINE
1 x 8 x 15½
BOTTOM BOARD
B
CLEAR PINE
½ x 3¾ x 17
H
1 DIA. x 16⅛ DOWEL
G
1 x 1¾ x 15½
DRILL 1 DIA HOLE x ½ DEEP
A
(2 REQ.)
F
1 x 1¾ x 14
D
1" x 2¾ x 14"
SAW ⅛ x 8¼ SLOT FOR HAND SAW
⅝ DIA. HOLES FOR 1½ x 10 FL HD. SCREWS
1" SQUARES
E
(2 REQ)
I
(2 REQ)
⅛ x 15½ x 19½
PEG BOARD
NAIL PARTS D, E & F FROM INSIDE USING 1¼ BOX NAILS
ATTACH PEG BOARD AT EACH CORNER & AT MIDDLE WITH ¾ -18 GA. WIRE NAILS OR ¾ x 6 RD. HD. WOODSCREWS
NAIL PART C TO PART E FROM BELOW
OVAL HD. BRASS OR CHROME SCREWS

Also, cut part C, which is 1 x 8 x 15½ inches long for the bottom panel; part G, which is 1 x 1¾ x 15½ inches for the top stretcher; and part D, which is 1 x 2⅝ x 14 inches for the insert separator strip that is nailed to the bottom panel. Only one of each is needed for these latter three parts.

Fasten the E strips to the sides with 4d box nails (A) where indicated on the sketch, on the same sides as the half-depth holes made for the handle. Place bottom panel C against the lower ends of the E strips, and attach with the box nails. Cut the dowel handle 1 inch longer than the G strip and insert in the holes of the sides. Nail the G spacer strip along the top to the vertical E parts, then fit the lower spacer D in place between the E parts. (Note: it may be necessary to adjust the length of this D insert somewhat to fit snug between the E parts.) Check to see that this basic assembly is square, with the distance uniform between the E parts.

In one of the sides, cut a slot ⅛-inch wide, and about 8¼ inches high, to receive the hand saw. This slot can be made easily with a saber saw, held at an angle until the kerf is started, then straightened up until the length of the slot is completed, cutting through both the E and A parts on that side.

Next step is to cut the two pegboard pieces, each ⅛ x 15½ x 19¼ inches, and attach them to the spacers composed of the D, E, and G parts. Attach the pegboard panels on each side of the spacers with ¾-inch wire nails, or better still, use number 6 round head screws for a strong, permanent mounting.

Final step is to cut two pieces of stock for the outside facings which will form compartments to hold the glass hardware jars. These B parts are of ½-inch stock, 3¾ x 17 inches in size, and are attached with two #6 ¾-inch oval head brass screws at each end.

The tool caddy may be finished neatly with just a coating of shellac or varnish, while the pegboard tool panels should be painted a light color for contrast. Some of these panels may be purchased with a factory-applied primer or enamel finish, which will save time needed for finishing.

It's a good idea to mark each space for the tool it is reserved to hold, so that you can easily spot whether any are missing when the work is completed. Slip the saw into its slot on the side, hang the tools on the special pegboard tool fixtures, and make up a basic assortment of screws and nails for the hardware supplies, and you're ready.

Original design by Steve Ellingson.

See also: CABINETS; TOOL CHEST; WORKBENCH; WORKSHOP.

MATERIALS LIST

Quantity	Size and Description	Purpose
1	1" 10"x6' select grade pine	Parts A, C, D, E, F, and G
1	½" 4"x3' select grade pine	Part B
1	1"x2' hardwood dowel	Part H
1	⅛" 2'x4' tempered hardboard with perforations	Part I
as needed	1½" #10 flat head wood screws	
as needed	¾" #6 brass oval head screws	
as needed	¾" 18-gauge wire nails	

NOTE: Also need 4d box nails and finishing materials.

Build a Sawhorse Mini-workshop

This deluxe sawhorse includes a carry-about tool box, storage space and an extra sawhorse to combine a lot of use into a little space

THIS IS NOT JUST A SAWHORSE, but a workshop which will save you many steps around the house because it can be easily moved from one job to another. Hand tools can be stored in the space beneath the top, while bins located between the legs hold small portable electric tools, such as a drill, sander and saw. A shelf holds a carry-all tool box which, in addition to holding handsaws, plane irons and other tools, has a drawer for chisels, bits, screwdrivers and an assortment of nails and screws.

The tool box also serves as a base into which a rack may be inserted to make a support the same height as the sawhorse. When used in conjunction with the sawhorse, this rack is useful for supporting full sheets of plywood or long lengths of lumber when sawing them to smaller pieces, or for dressing down doors. An L-shaped vise can be used to hold doors on their edges when dressing the stiles and fitting hinges. The generous width of the top of the sawhorse provides a wide platform for use when painting walls and ceilings.

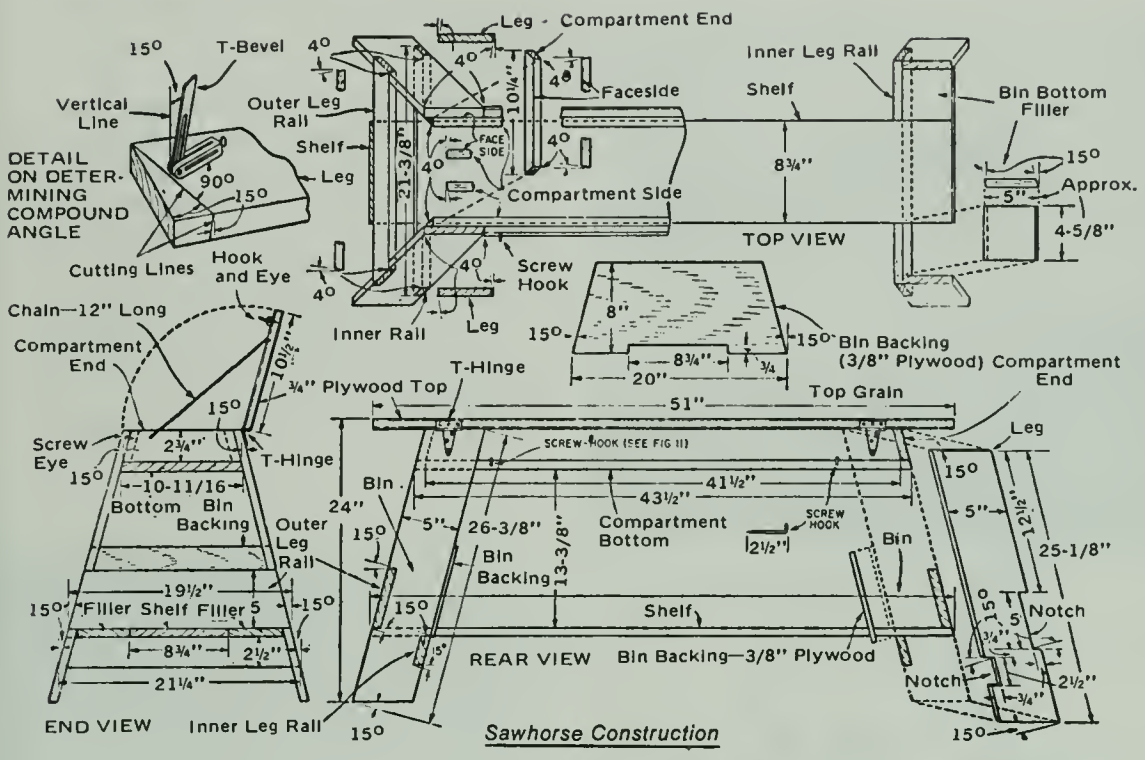
Building the sawhorse. To insure the proper fitting of the parts for the sawhorse, pay particular attention to the compound angles to which these parts are cut. Unlike making right angle ripping or crosscuts on a circular saw, the compound angles used here require settings of either 4° or 15°, or a combination of both.

While the circular saw simplifies the cutting of these compound angles, satisfactory results can be obtained with a crosscut handsaw. The blade of a T-bevel, set to the proper degree with the aid of a protractor, is used as a visual guide for determining the required slant to which the saw is held. The handle of the T-bevel is positioned on the work at a 90° angle from the cutting line. The 4° and 15° bevels on the edges can also be made with a hand plane. Retail lumberyards will rip stock to the widths designated in the Materials List. Unless otherwise specified, all ¾-inch stock members for the sawhorse and tool box are

▲ *Convenient bins at each end hold an assortment of portable electric tools.*

▲ *The weight of the tools in the sawhorse prevents it from creeping when planing boards held in vise. Its 24-inch height is a comfortable working level for people of average stature.*

➤ *The drawer is partitioned to hold the small workshop necessities. To protect cutting edges of chisels, install special brackets or clips in the larger compartment.*



joined with coated 8*d* common wire nails, and an adhesive, such as white glue, applied to the joints.

Cut all of the pieces for the sawhorse from the dimensions given in the drawing and start assembling them by nailing the compartment sides and ends together to form a frame. Add the compartment bottom which is beveled 15° on all four edges. The four legs are sawed alike in size and shape up to the point when the rail notches are made. Make duplicate notches on the legs. When notching the legs, the cutting angles of the first set of legs are the reverse of those used on the second set. Follow the angles shown in the drawing. Attach the legs to the compartment sides, cutting off or

The supporting rack set in the tool box holds one end of a large piece of work on a level with the sawhorse. The sawhorse is not shown in this photo.

▲ *Making the lateral cuts in the legs for the rail notches. Note stop block clamped to the 2-inch high fence which, in turn, is fastened to the miter gage.*

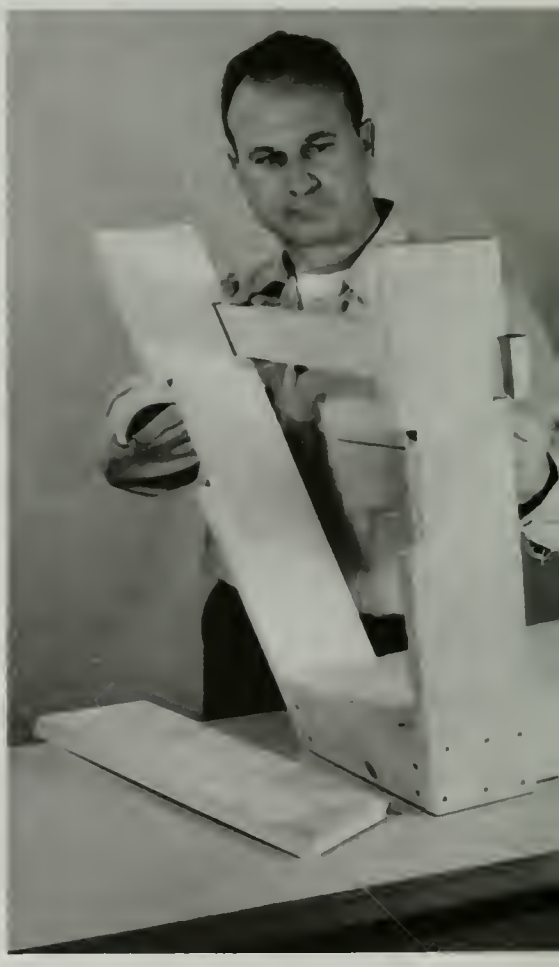
▼ *When removing the waste material from the rail notches, the initial cut is made with the table tilted 4° to the right. In the finish cut, the leg is reversed, end for end, and the table tilted 4° to the left.*

clinching over any nails which protrude on the inside. Add the rails next, then install the shelf.

Fasten the bin bottom fillers to the rails with 6*d* nails and nail the bin backing to the legs with 4*d* nails. Before installing the hooks, eyes and chain to the top, give the wood (except for the working surface of the top) an enamel undercoating. When dry, smooth with steel wool and apply two coats of an interior enamel. Give the unpainted portion of the top two coats of boiled linseed oil.

Take-about tool box and rack. Scribe the

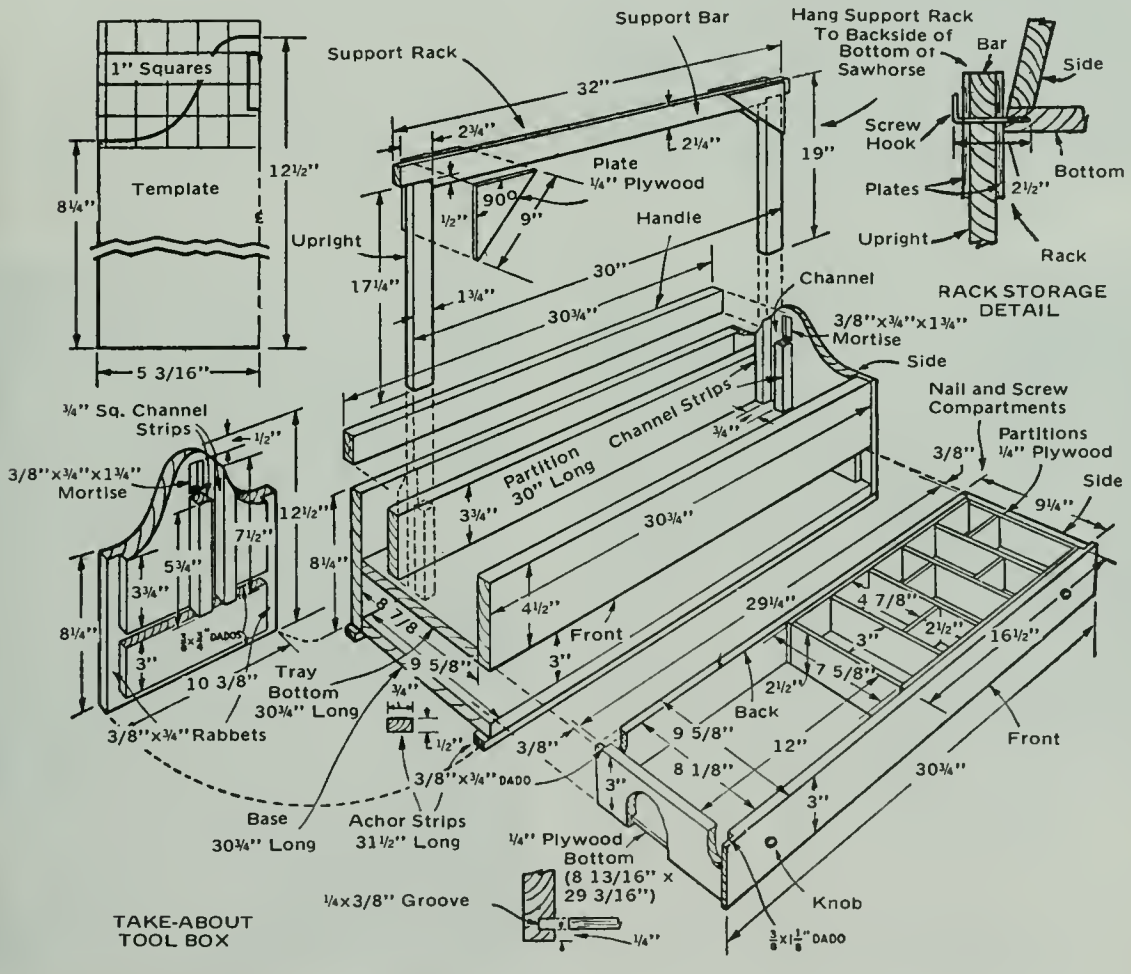
▼ *Installing the inner rail. Note outer rail in left foreground.*



cutting lines for the contoured portions of the side or ends with the aid of a cardboard half-template, as shown in the drawing. After cutting the dadoes, rabbets and handle mortises, join the sides to the tray bottom and handle. Next add the base, front and back.

When installing the channel strips, check their spacing so that the ¾-inch stock, used for the uprights of the supporting rack, slides freely in the channels thus formed. Shape the upper ends of the longer channel strips to conform to the contoured portion of the sides. The partition, which forms a compartment for handsaws, rests against the channel strips and is anchored with 8*d* finishing nails driven in through the sides. Anchor strips nailed to the bottom prevent the tool box from sliding off the shelf.

Cut the end dadoes on the drawer front and sides and then make the ¼ x ⅜-inch grooves in these members (including the back) for the bottom. Join the sides to the front, slide the bottom in the grooves and add the back. Cross-nail with 6d finishing nails. Assemble the parts for the nail and screw compartments with ¾-inch brads and glue before installing in the drawer.



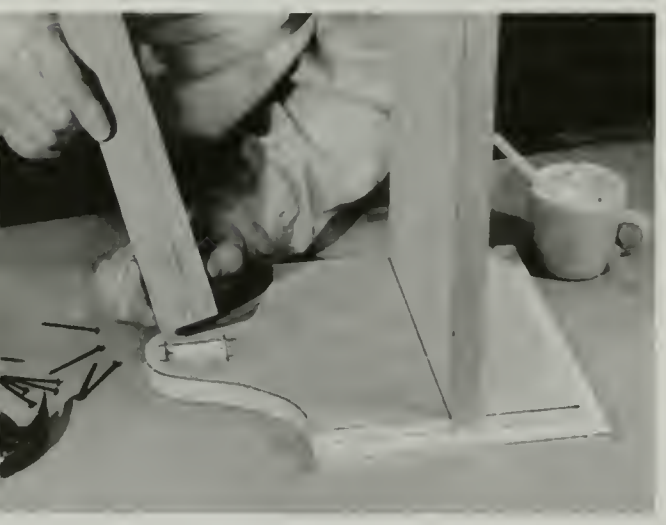
Installing the shelf which holds the tool box. Shelf is nailed to the inner and outer rails.

Anchor the unit in place with brads and add the knobs to complete the drawer.

The support rack is made of a hardwood bar (preferably oak) and two uprights. Drive 10*d* finishing nails through the bar and into the uprights. Coat the plywood plates with glue and attach them to the rack with lath nails. When not in use, the rack can be hung on the sawhorse. The rear view diagram of the sawhorse shows the approximate distance of the screw hooks from the legs.

Recess the heads of the finishing nails and paint the box, except the sides, back, bottom and inside of the drawer, with an enamel undercoater. When dry, fill the nail holes with wood putty and smooth the surface with steel wool. Apply two coats of interior enamel of the same shade as you used on the sawhorse. As with the sawhorse, coat the unpainted surfaces with boiled linseed oil. F.H.

See also: TOOL CHEST; WORKBENCH;WORKSHOP.



When assembling the tool box, mount the tray and handle to one of the sides, then add the other side.

A 12-inch length of chain, attached with 3/4-inch screws at each end of the sawhorse, limits the swing of the top.

MATERIALS LIST—Sawhorse

Quantity	Size and Description	Purpose
2	3/4" 3"x41 1/2" pine	compartment sides
2	3/4" 3"x10 1/4" pine	compartment ends
1	3/4" 10 11/16"x43 1/2" pine	compartment bottom
4	3/4" 5 1/8"x26 1/2" pine	legs
2	3/4" 2 3/4"x21 1/4" pine	inner leg stretchers
2	3/4" 5 1/4"x19 1/2" pine	outer leg stretchers
1	3/4" 8 3/4"x51 1/4" pine	shelf
4	3/4" 4 3/4"x5 1/8" pine	bottom bin fillers
2	3/8" 8"x20" plywood	bin backing
1	3/4" 10 1/2"x51" plywood	top
1	24" link or safety chain	
as needed	#7 3/4" round head screws	

NOTE: Also need T-hinges, hooks and eyes, glue, coated wire nails, finishing nails, lath nails, enamel, enamel undercoater and boiled linseed oil.

MATERIALS LIST—Tool Box

Quantity	Size and Description	Purpose
2	3/4" 10 3/8"x12 1/2" pine	box sides
1	3/4" 8 7/8"x30 3/4" pine	box tray bottom
1	3/4" 1 3/4"x30 3/4" hardwood	box handle
1	3/4" 9 5/8"x30 3/4" pine	box base
1	3/4" 4 1/2"x30 3/4" pine	box front
1	3/4" 8 1/4"x30 3/4" pine	box back
2	3/4" 3/4"x5 3/4" pine	box channel strips
2	3/4" 3/4"x7 1/2" pine	box channel strips
1	3/4" 3 3/4"x30" pine	box partition
2	3/4" 1/2"x31 1/2" pine	anchor strips
1	3/4" 3"x30 3/4" pine	drawer front
2	3/4" 3"x9 1/4" pine	drawer sides
1	1/4" 8 13/16"x29 13/16" plywood	drawer bottom
1	3/4" 3"x29 1/4" pine	drawer back
6	1/4" 2 1/2"x7 5/8" plywood	nail compartment ends and partitions
2	1/4" 2 1/2"x16 1/2" plywood	nail compartment front and back
4	1/4" 2 1/2"x3" plywood	nail compartment partitions
2	3/4" 1 3/4"x17 1/4" pine	support rack uprights
1	3/4" 2 1/4"x32" hardwood	rack support bar
4	1/4" 4 1/2"x9" plywood	support rack plates

NOTE: Also need knobs, screw hooks and finishing materials.

Two Tool Chests You Can Build

Either of these tool chests will keep your tools handy and well organized, whether you're working at your bench or at some far away job site

EITHER OF THESE tool box designs will enable you to keep your tools organized in a safe, convenient way. You can keep either chest set up at the end of your workbench to keep the tools handy. If you want to work elsewhere, just close the chest and carry it to the work. Everything you need will be handy.

To make the two-compartment tool chest, the one with a back door and a front door, start by sawing the top, bottom and sides to size first. Rabbet both ends of the top and bottom and run the dado for the center divider right down the center of all three pieces. The right hand side piece also needs a dado for the center shelf of the small drawer compartment.

Next, cut the parts for the drawer compartment. Nail and glue the right-hand side to the bottom and add the drawer compartment. Then glue in the drawer shelf and the left side. Cut the center divider panel, making the the cutout for the drawer compartment just a trifle oversize so you can trim after a trial fit to be sure you get a snug joint. Then add the top of the chest.

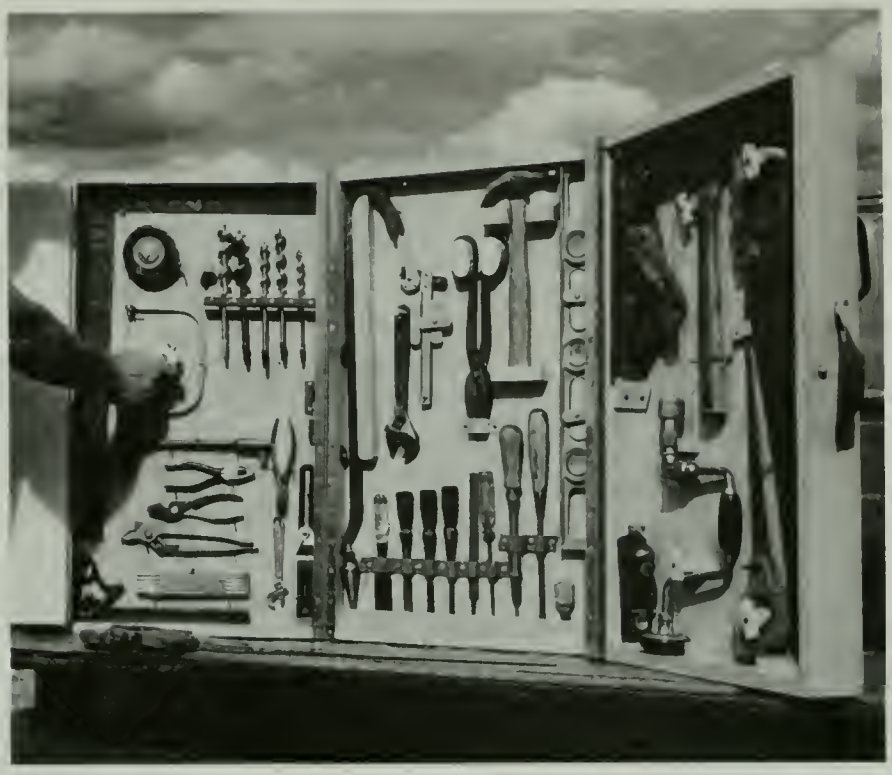
Make U-shaped cuts in both end pieces of each drawer to serve as finger pulls, and after the drawers are assembled, sand them for a good sliding fit. Next, add the three side strips, using glue and brads. Cut the doors to fit. When you hang the doors, be sure to favor the outside edge of the chest so they clear the drawers. Screws supplied with the hinges may be longer than the door thickness. If so, drive them home in undersize holes after dipping in glue and then file the projecting points flush on the inside. Be sure to allow clearance on the bottom edge of the doors so they will swing freely when the chest is set up.

Make the screwdriver-holding shelf and the pliers rack to fit your own tools. Simply cut wide dados in wooden strips to fit the handle width of your tools. Saws are best held on blocks shaped to fit the tool's grip, while hammers can be supported with spring-type catches available in hardware stores. Screw eyes and screw hooks will also hold many types of tools.

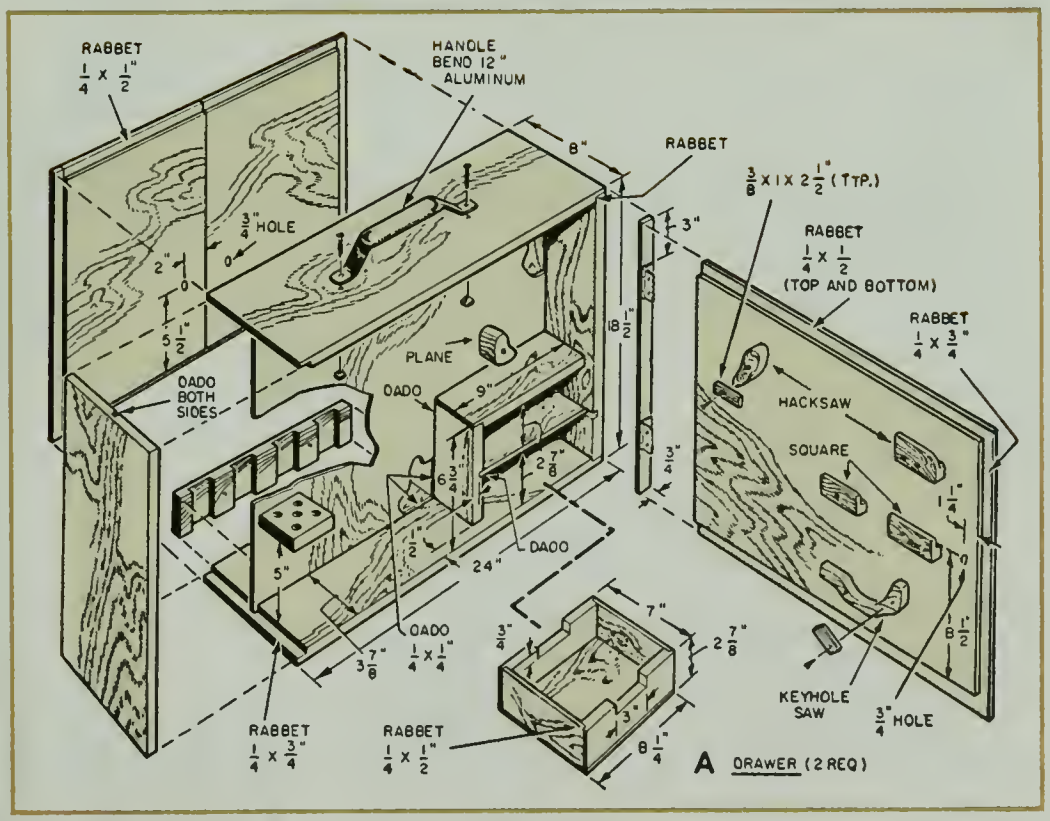
A carrying handle can be made by flattening the ends of a 12-inch length of aluminum tubing and bending it to shape. Or you may want to use a screen door handle. Paint or a few coats of resin-type sealer will protect the wood against dampness.

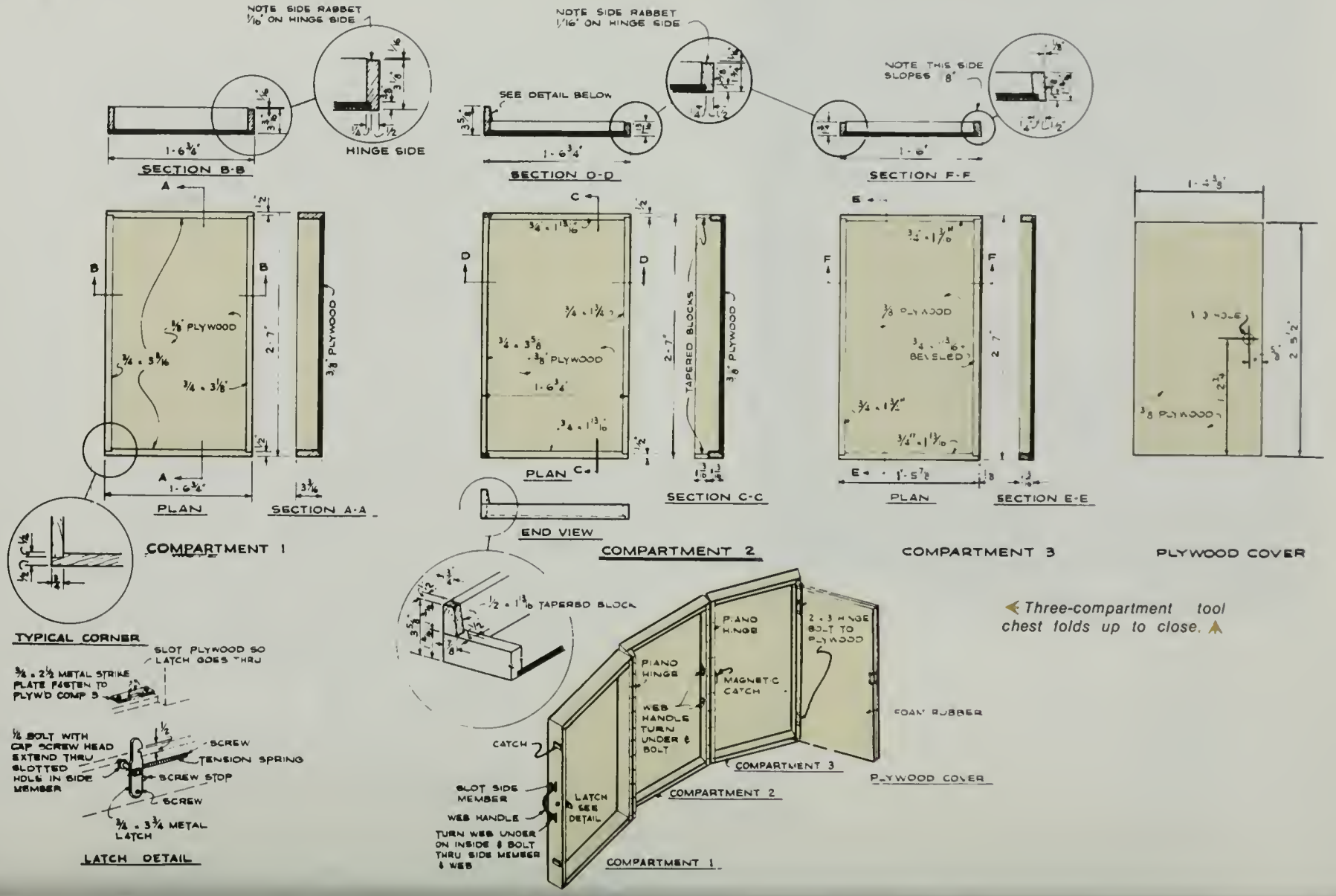
If you build the three-compartment tool chest, glue and nail the framing members

➤ *This three-compartment tool chest will keep your equipment organized and handy, whether it's used on the job or in your workshop.*



➤ *Two-compartment tool chest has a back door and a front door.*





Three-compartment tool chest folds up to close.

first, then insert the plywood sides and separator panels. Use panel thicknesses specified in the plans. Thicker panels will increase the weight substantially and thinner panels will not provide sufficient stiffness.

The tool fastening methods vary with your needs. Some items that come in containers—drills, chisel sets, etc.— can be left in their containers. Simply fasten the container to the inside of the chest.

See also: CABINETS; TOOL CADDY; WOODWORKING; WORKBENCH; WORKSHOP.

MATERIALS LIST—Three Compartment Tool Chest

Quantity	Size and Description	Purpose
1	3/8" 16 3/8"x29 1/2" exterior grade plywood DFPA A-B or A-C	cover
2	3/8" 17 3/4"x30" exterior grade plywood DFPA A-B or A-C	back
1	3/8" 16 7/8"x30" exterior grade plywood DFPA A-B or A-C	back
1	1" 6"x14' stock	top, bottom and sides
1	1" 3"x3' stock	top and bottom of compartment 3
2	3/4"x27" piano hinge	
2	1 1/2"x1 3/8" hinges	
2	1"x12" web handles	
4	3/16"x1" stove bolts, washers and nuts	

NOTE: Also need latch, catches, 4d finishing nails, screws, waterproof glue and finishing material.

MATERIALS LIST—Two Compartment Tool Chest

Quantity	Size and Description	Purpose
2	1/2" 8"x24" fir plywood	top and bottom
2	1/2" 11"x18 1/2" fir plywood	doors
1	1/2" 18 1/2"x23 1/4" fir plywood	door
2	3/4" 8"x18" fir plywood	sides
1	3/4" 7"x9" fir plywood	drawer top piece
1	3/4" 6 1/2"x7" fir plywood	drawer end panel
4	3/4" 2 5/8"x8 1/4" fir plywood	drawer fronts
1	3/4" 3"x3" pine	screwdriver shelf
1	3/4" 3"x13 1/2" pine	pliers rack
1	1/4" 18"x23" fir plywood	center divider
1	1/4" 7"x8 3/4" fir plywood	drawer shelf
4	1/4" 2 5/8"x6 1/2" fir plywood	drawer sides
2	1/4" 7"x8 1/4" fir plywood	drawer bottoms
3	1/4" 3/4"x18 1/2" pine	door strips

NOTE: Also need butt hinges, spring-type cabinet door catches, aluminum tubing, finishing nails and glue.

Bottom saw was as rusty as the top one until it was cleaned with a rust remover and steel wool.

Maintaining Hand Tools

Sharp, rust-free, well cared for tools make work a pleasure

THE BASEMENT, where most tools are generally kept, is probably the worst place to keep them. Few basements are dry enough. A jar of silica gel or magnesium chloride in each tool drawer will help dry the air. Wipe metal parts of hanging tools with a rag saturated with light machine oil.

Nothing is as bad for your saw as your own perspiration-laden fingerprints. These help generate rust. Try not to touch the blade anymore than necessary; wipe after handling.

If your tools do rust, there are several dependable rust removers that will work, unless corrosion has pitted the metal. Keep a bottle of rust remover on hand, and a package of fine steel wool to use with it.

Store tools carefully. Chisels and other keen-edged tools should be in individual compartments where edges won't be dulled against metal objects. Planes should be laid on their sides. Drills and bits may be racked, rolled in oiled canvas, or laid carefully in a wood-lined drawer. Even files will become dull if left in dusty or greasy places. Rack up handsaws or store them in slotted drawers.

Check wood handles for splinters or rough spots. Fine sanding followed by a light wiping with linseed oil will keep handles trim.

Accurate work with cutting tools—saws, chisels, planes, files, gouges, knives, scrapers—demands sharpness. Of all these, only the handsaws may need a professional's touch for sharpening. The others you can keep keen yourself.

See also: CHISELS; HAND TOOLS; KNIVES AND AXES; SAW; SHARPENING; TOOLS, GARDEN.

If you don't keep your handsaws in a wall rack, protect them with this simple device. Split length of rubber tubing as a sheath for the teeth.

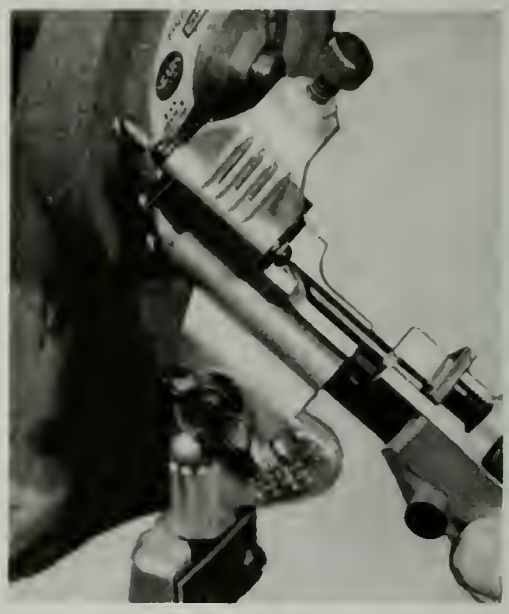
If you cannot remove a kink in your saw by hand pressure, lay the blade on a wooden surface and tap the kinked area gently with a wooden mallet.

Remove rust from saw blade with rust solvent, rubbing with steel wool and wetting and re-rubbing until metal is clean and bright once again.

Keep the bed of your plane smooth and dry. Use steel wool to polish the bottom, rust remover if needed. A paraffined bed moves well on wood.

Smooth the tops of wood-handled chisels with fine sandpaper. Even if you use a wooden mallet, handle may become battered and rough on palm.

You can help keep your files clean and in good working order by stroking with a file card —a kind of wire brush with short, stiff bristles.



To sharpen, use an inexpensive bit holder.

To tune up your axe, stroke file across the blade; lift in circular motion to clear blade on return stroke. Sharp axe is essential for safety.

To replace broken hammer handle, cut off close to head and drive out stump. File or grind new handle to fit and drive into place, then wedge.

If wedges fail to hold hammer head tightly, rub top of the handle with a mixture of glycerin and water. This swells the wood for a tight fit.

A loose pivot nut and bolt will impair the action of pliers. Tighten bolt and nut for free play without wobbling, then lock nut with a center punch.

Sharpen the fine serrations at the jaw end and coarser ones in the middle. Renew jaws by stroking with slim taper file in each valley.

Get the Most from Your Portable Circular Saw

If you have much sawing to do, a portable power saw will save you time and labor, and in some cases increase the accuracy of your work

A PORTABLE CUT-OFF SAW will save you time and effort. A 2 x 4 that takes 45 seconds to cut off with a handsaw takes 3½ seconds to cut with a cut-off saw; a square cut across a 1 x 12-inch pine board, requiring 30 seconds with a handsaw, is cut in 4 seconds with a cut-off saw. Difficult 40° by 40° compound miter cuts on a 2 x 4 take 190 seconds by hand—27 seconds with a cut-off saw. A 4 x 8-foot sheet of plywood, hopelessly unmanageable with a conventional bench-type circular saw, is reduced to handling size in two or three minutes with a cut-off saw.

An electric motor supplies the power for the actual sawing, all you do is lift and guide the saw across the boards. As far as accuracy is concerned, regardless of your skill with a handsaw, the built-in guides and protractor on a cut-off saw will assure you a straight and square cut, or beveled if desired, every time.

Several sizes of cut-off saws are available. An easily handled little saw with a 5½-inch blade having a 1¾-inch depth of cut and weighing just under 12 pounds is an ideal size for the homeowner. It will cut through all thicknesses of hardboard, and plywood, and solid lumber up to 2-inch (actually 1⅝-inch) thickness. It's a good size for building a basement room; cabinets and shelving; fitting storm-windows; building a fence or similar light jobs.

Larger cut-off saws weighing up to 19 pounds with 7½ to 8½-inch blades will miter cut 2-inch stock at a 45° angle. This is a building contractor's size and will handle all lumber used in building a house or garage. The 8½-inch blade has a 3-inch depth of cut and will sever a 6 x 6-inch timber by making cuts on opposite sides. These larger saws can also be used on lighter work because weight of saw on most cutting operations is supported by piece being cut.

There are two precautions to observe when using portable electric tools. One is the matter of extension-cord size. The compact motors draw quite a lot of current, requiring rather heavy cords; the longer the cord used, the thicker the gage of the wire should be (refer to the accompanying table). Most machines have the amperage marked on the case.

The second precaution is that of grounding, a must if the machine is used outdoors when the ground is damp. Many saws are equipped with three-conductor cords, one

conductor for grounding the tool to guard against electrical shocks. Follow directions given by the manufacturer. Three-conductor extension cords and plugs are available.

The saw blades are guarded above by the housing and beneath by an automatically telescoping guard which can be drawn up with a handle when necessary to get it out of the way. The base plate is pivoted sidewise for making square and angular cuts, and is also hinged on the front end or otherwise designed for regulation of depth of cut. An adjustable gage guides the saw for ripping length of pre-determined width. Some machines have clutches which slip if blade is overloaded or strikes an obstruction, thus preventing damage to the motor.

Many types of saw blades are available. The combination blades, either fast or smooth-cutting types, are best for all-round work requiring ripping and crosscutting. The specialized types are reserved for long runs of crosscutting or ripping. For difficult-to-saw materials, carbide-tipped and deep-hardened blades are used. Blades for sheet metal are also available. In general, set the blade only deep enough to project the teeth on the underside of the board for easy sawdust venting.

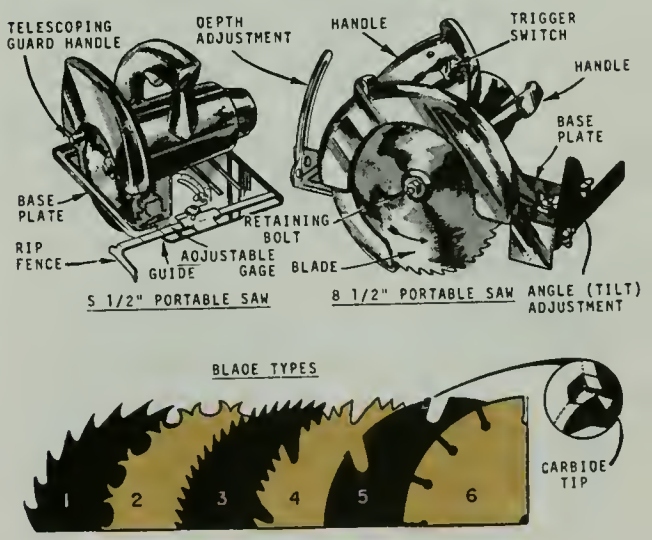
Crosscutting is the most frequent job. On a building this may be the sawing of a fire block from 2 by 4-inch stock, a freehand technique guided by the eye. Rest the stock on sawhorses, or hold with your left hand with the end resting on the ground, as shown in the drawing. The blade will shear through it, severing the piece before it starts to fall.

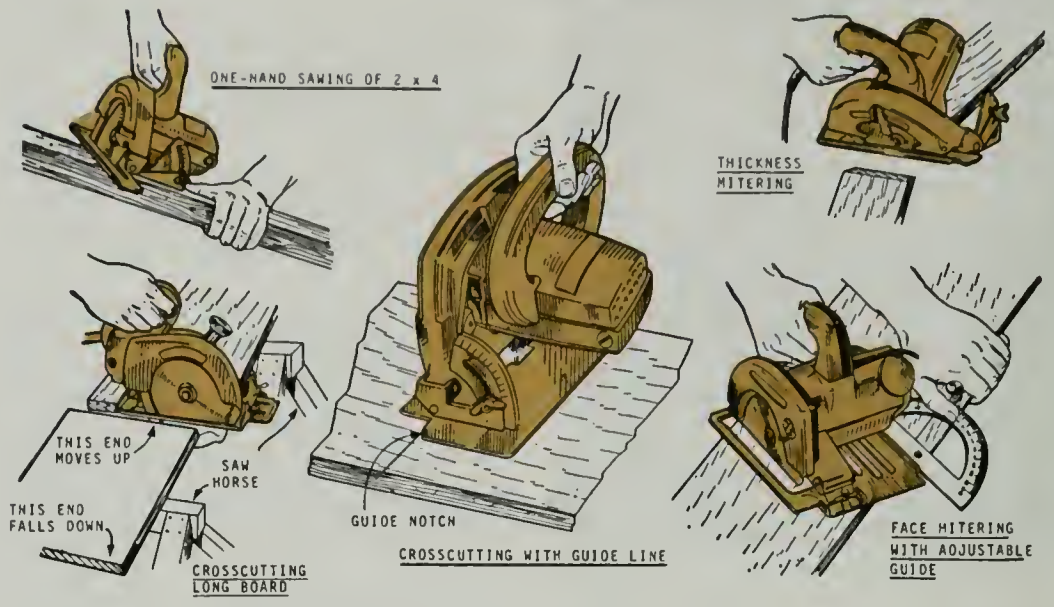
To cut a long piece from a board on sawhorses, shift the board until the horse at the right is near the center of the section to be cut, but with a little extra length at the end. Hold the near board with the left hand. As the piece is sawed through, the cut end will gently rise, thereby preventing jambing or splintering.

A board on a pile can be crosscut by sliding it endwise to clear the part to be cut, the projection being held with the left hand while it is severed from the rest. If the piece is long, block up the far end. When cutting to a line, set the guide notch on the line and follow it. By leaning to the right you can see both blade and line, a help in getting started.

Using the saw for bevel cutting is shown in the drawing. Loosen the wing nut at the tilt quadrant and slope the base as required, reading the degrees on the scale. Tighten the nut and handle the saw as in plain crosscutting. Mitering or other angle cutting across the face is a matter of following the guide line. Accuracy is improved by the use

Typical saw blades. No. 1, combination blade, fast-cutting. Similar tooth without front bevel and with more set for ripping only. No. 2, hardened throw-away reversible blade. When dull, turn over and use sharp teeth. No. 3, crosscut for smooth and fast cutting. Smaller, harder teeth for cutting into floors and walls where nails are encountered. Fine teeth for use on fibrous insulation wallboard. No. 4, combination blade; with set, fairly smooth-cutting; without set and hollow-ground, very smooth-cutting. No. 5, carbide-tipped teeth for long life. Not for ferrous materials. No. 6, slitted friction saw which cuts sheet metal by melting a kerf through the material. Slits keep the blade cool.





of an adjustable protractor guide, the stock of which is held against the edge of the board. Details for making a guide with a strip of coarse sandpaper glued to the contacting edge to make it slip-proof is shown in the drawing.

Compound miters for bins and flower boxes, hip and valley rafters, and similar work, are just about as easy to cut as lopping off the end of a board. Tilt the saw and mark the angle across the face of the board, or use a protractor guide.

To saw a plywood panel, lay the smooth or face side down on horses since most of the splintering occurs in the upper side. If necessary, pad the horses to prevent scuffing the face side. Hardboards and similar sheets coated with finishing materials should also be cut with the finished or polished sides down and resting on suitable pads. When cuts across the horses must be made, block up the panel with scrap 1 x 2-inch stock to clear the horses. For ripping, set the gage by the calibrations, or by measuring from the inner face to the far-set tooth. Slide the fence along the edge of the wood when ripping. For rough cutting, follow guide lines; for careful work use a straightedge against which to slide the saw base. To locate the straightedge, add to the width of the piece to be cut the distance from the right edge of the base to the tip of a blade tooth set toward the left. Tack or clamp the ends of the straightedge to the stock being cut.

When the part to be sawed off is too narrow to carry the straightedge, subtract the distance from the left edge of the saw base to the left set tooth of the blade from the width and clamp the straightedge, again placing the kerf to the right of the line. Slide the left edge of the saw base against the straightedge.

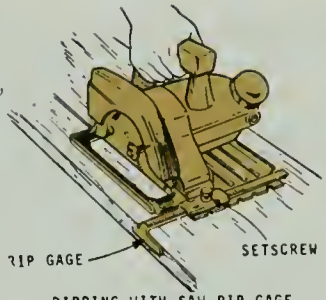
To saw inside holes, such as an opening in a drainboard apron to receive a breadboard, or a rectangle in a plywood door for a grill, set the blade for a deep cut, draw the guard back, and lower the rotating blade into the work as the saw is steadied on the forward end of the base. Start the cut enough forward of the end mark to avoid slitting beyond it. If the pocket is narrow, chisel out the ends and finish with a wood file; if wider, bore a corner hole and use a compass saw or portable jig saw.

Get the Most from Your Portable Circular Saw

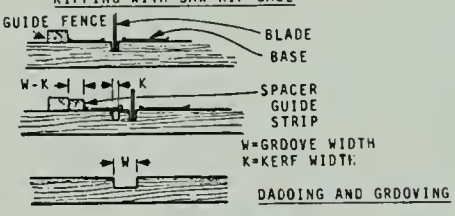
Plywoods and hardboards dull saw teeth rapidly. If there is much work to be done in these materials, a carbide-tipped blade is an economy, because it will stay sharp 20 times as long as an ordinary blade. The saving in sharpening time and loss of time due to changing blades more than offsets the greater cost. The hard-pointed "throw-away-blades" can be touched up two or three times by grinding on an ordinary emery wheel before they become worthless.

Dadoing and grooving can be done with a cut-off saw by setting the blade to the required depth of cut, and then cutting the sides of the groove. Clearing the groove can then be done with saw cuts between the sides or with a chisel. If the blade can't be fully retracted, rest the saw bottom on a piece of thin hardboard to saw through. Clamp a guide fence for cutting one side of the dado, then lay a second strip against it, of width equal to the dado minus the kerf width, and make the second cut. Grooving cutters are available for some saws.

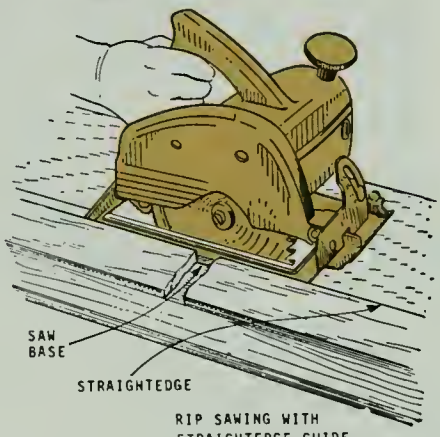
A homemade stand for converting a portable saw into a stationary one is shown in the drawing. Use ¾-inch five-ply plywood. Use a stiff metal plate rabbeted flush into the top against which bottom of saw is clamped. One edge of saw bottom is held by a stationary block, the other by a sliding block locked with a wing nut. Miter gage



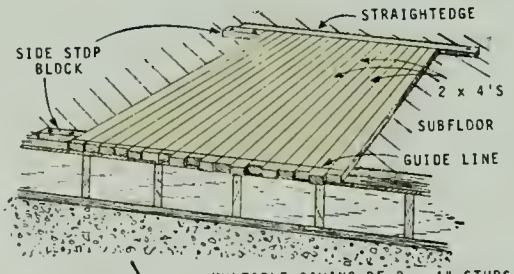
RIPPING WITH SAW RIP GAGE



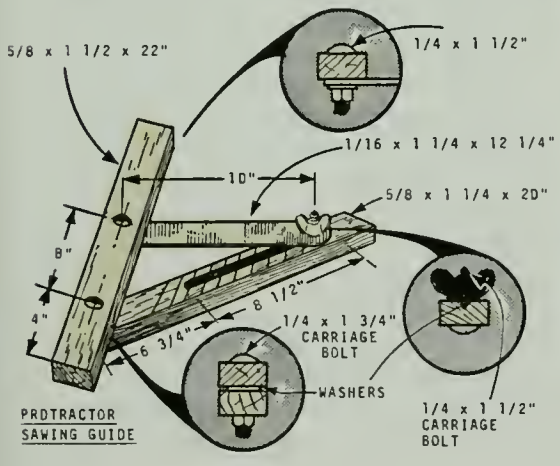
DADOING AND GROOVING



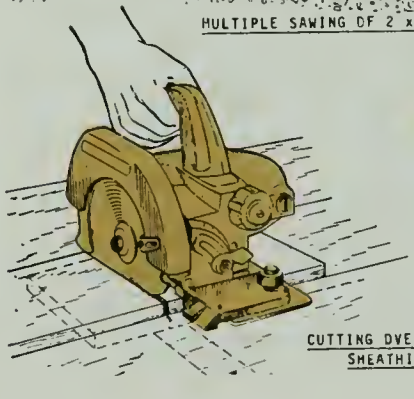
RIP SAWING WITH STRAIGHTEDGE GUIDE

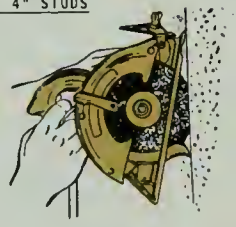


MULTIPLE SAWING OF 2 x 4" STUDS



PROTRACTOR SAWING GUIDE

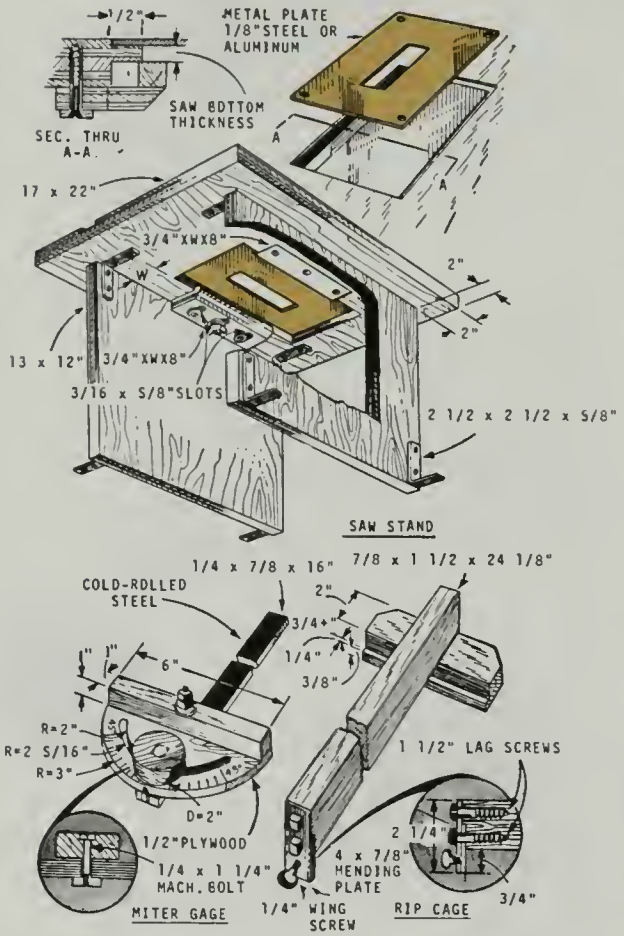

CUTTING OVERLAPPING SHEATHING


CUTTING INTO STUCCO WALL WITH ABRASIVE DISC

EXTENSION CORD					
	Cord Length in Feet				
No. Amps.	50	100	150	200	300
9	16	14	12	12	10
9.5	16	14	12	10	8
11	14	14	12	10	8

and rip fence are built of wood. The head of the miter gage is locked with a wooden knob into which the bolt head is sunk. Drill and tap the cold-rolled steel guide for the bolts. Countersink underside and rivet end of pivot bolt after it is screwed in place.

Fasten the square-head of the rip fence with glue and wood screws. Make the clamping mechanism from a 4-inch mending plate sawed into 2¼ and 1¾-inch pieces. Notch the short piece into the near end of the fence. Attach them to the end of the rip fence with two lag screws. Only the lower screw passes through the short metal piece. Drill and tap the long piece for a wing screw, which bears against the short metal piece, exerting pressure against the edge of the saw table when the screw is tightened. The telescoping guard on the saw emerges through the slot in the plate, guarding the blade. While a pull cable and catch can be rigged to operate the saw trigger switch, it is simpler to mount a plug-in receptacle with switch on the stand into which to plug the saw cord.

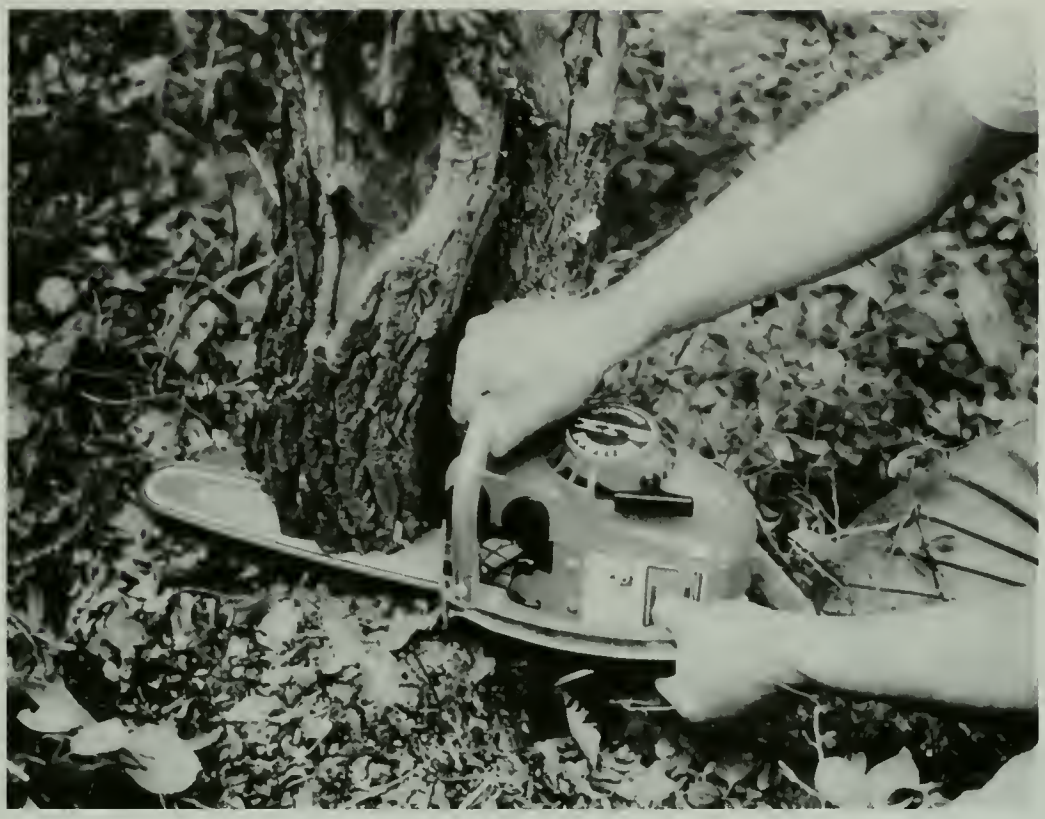


In house and garage building, a good deal of duplicate length pieces must be cut. A setup for sawing studs to uniform length is shown in the drawing. Lay a number of 2 by 4's edge-to-edge on a subfloor with the squared ends against a fixed straightedge and the far piece stopped against blocks which hold the group square with the straightedge. The ends to be cut project beyond the floor. A guide line is then chalked or penciled, or a straightedge tacked in place across the studs.

Single pieces of subfloor and sheathing are cut by holding the piece in hand, like the 2 by 4 in the drawing. Where two join end-to-end, they are tacked in place with ends overlapping, as in the drawing, and the blade allowed to cut through both pieces over the joist or rafter.

When cutting an opening in a wall for installing a door or window, the process is similar to cutting an inside hole in a board. If an abrasive disc is substituted for the saw blade, an opening in a stucco wall can be neatly sawed. Wear goggles to protect your eyes. The abrasive disc can also be used to cut metal tubing or rods. Clamp the work in a vise or hand-screw and cut off the projecting ends. Cut sheet metal with slitted blade the same way as sawing wood. E.M.L.

See also: POWER TOOLS; TOOL TECHNIQUES.



Get the Most from Your Chain Saw

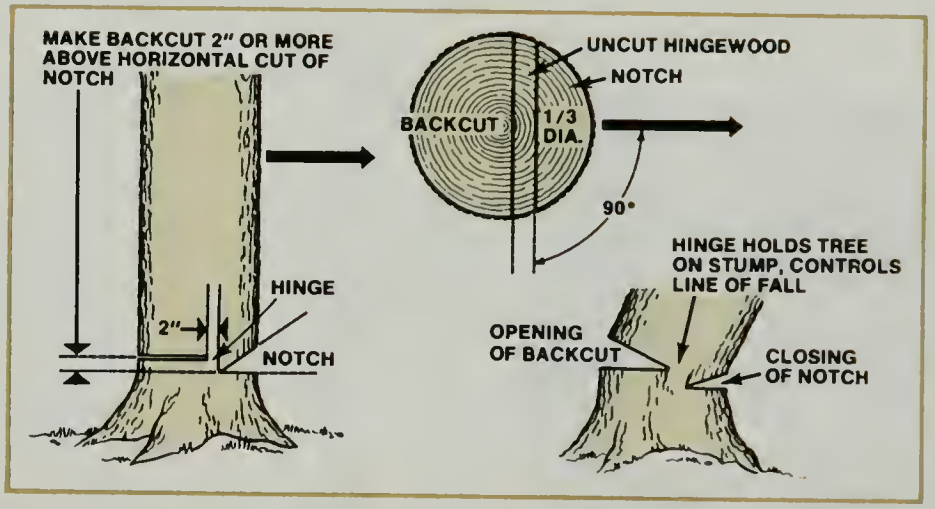
How to fell trees—even big ones—cut logs and what have you, with efficiency and safety

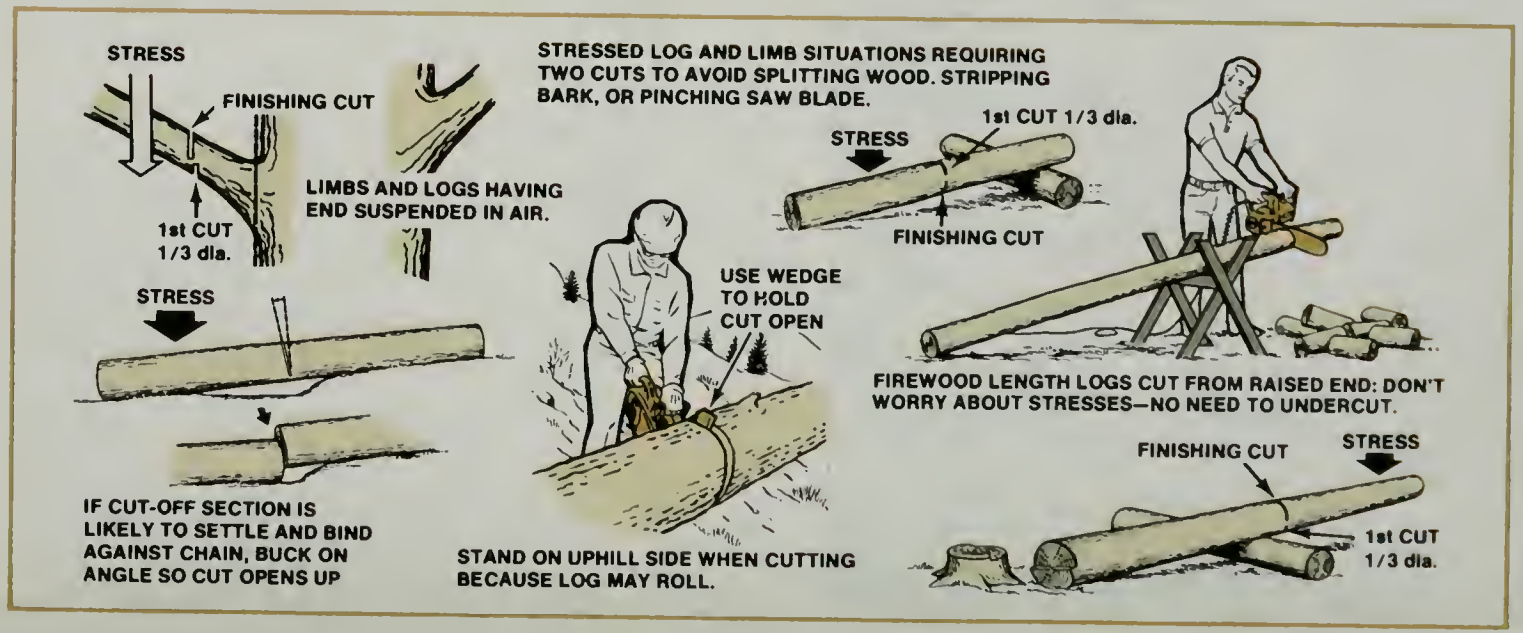
YOUR CHAIN SAW can save you hours of back-breaking labor, but it must be used correctly—and safely.

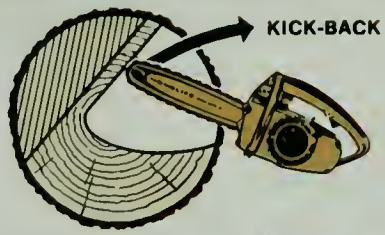
Start out by wearing safe clothing—non-slip shoes and work gloves, cuffless trousers and, in general trim-fitting garments with no loose ends that can get caught in the cutting chain. Wear safety goggles and, if you are working in the woods, a hard hat. If you plan to do extensive cutting for long periods of time for several days, you should wear a hearing protection device.

Never attempt to use the saw by holding it in one hand alone. Your left hand gripping the handlebar with fingers curled around it and the diameter of the bar in the webbing between your forefinger and thumb is the only thing that will allow you to control the saw if it kicks back toward you. In addition, never stand directly behind the saw. If you draw a line along the cutter bar and extend it backward, the line should pass to your right.

To start the saw, place it on level ground with the blade clear. Stay on the left side. You can steady it by placing your knee on the engine housing, but never reach across the saw or straddle it. Use your left hand to hold the grip and throttle and your right hand to pull the starter cord.


MAKE BACKCUT 2" OR MORE ABOVE HORIZONTAL CUT OF NOTCH
UNCUT HINGEWOOD
NOTCH
BACKCUT
1/3 DIA.
90°
HINGE
2"
NOTCH
HINGE HOLDS TREE ON STUMP, CONTROLS LINE OF FALL
OPENING OF BACKCUT
CLOSING OF NOTCH

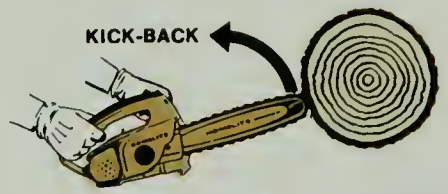

STRESS
FINISHING CUT
1st CUT 1/3 dia.
LIMBS AND LOGS HAVING END SUSPENDED IN AIR.
STRESS
IF CUT-OFF SECTION IS LIKELY TO SETTLE AND BIND AGAINST CHAIN, BUCK ON ANGLE SO CUT OPENS UP
STRESSED LOG AND LIMB SITUATIONS REQUIRING TWO CUTS TO AVOID SPLITTING WOOD. STRIPPING BARK, OR PINCHING SAW BLADE.
USE WEDGE TO HOLD CUT OPEN
STAND ON UPHILL SIDE WHEN CUTTING BECAUSE LOG MAY ROLL.
1st CUT 1/3 dia.
STRESS
FINISHING CUT
FIREWOOD LENGTH LOGS CUT FROM RAISED END; DON'T WORRY ABOUT STRESSES—NO NEED TO UNDERCUT.
FINISHING CUT
STRESS
1st CUT 1/3 dia.



DURING REINSERTION INTO A PREVIOUSLY BEGUN CUT, WHEN TOP OR NOSE OF BLADE HITS BOTTOM OR SIDE OF THE KERF (the cut)

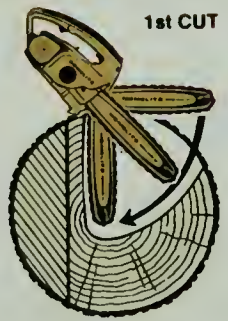
SITUATIONS CAUSING SAW BLADE TO KICK BACK TOWARD THE OPERATOR

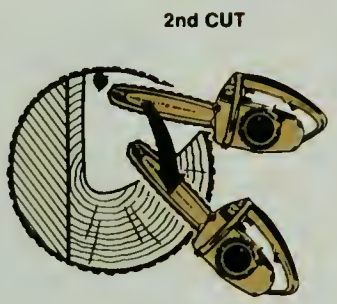
WHEN NOSE STRIKES SOME OBJECT SUCH AS ANOTHER LOG

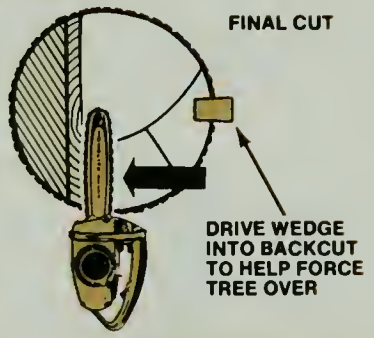


WHEN INCORRECTLY STARTING TO BORE

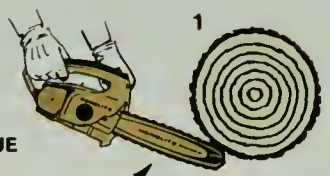
SEQUENCE USED TO FELL TREES UP TO TWICE BAR LENGTH IN DIAMETER



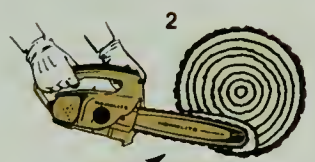




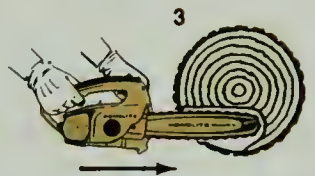
BORING TECHNIQUE



ANGLE THE BAR AND CUT INTO THE LOG AS IN #2



GRADUALLY MAKE THE BAR COME LEVEL



BORE STRAIGHT INTO LOG THEN CUT UP OR DOWN AS REQUIRED

Flip the ignition switch to "on." If the engine is cold, push the choke lever to the full position, open the throttle and give the cord a firm pull. Ordinarily a cold engine requires several pulls to prime and start. In cold weather, even more cranking may be necessary.

If the engine fires but does not keep running, push the choke to the half-way position and crank again. When it starts, keep the choke at half until the engine warms up.

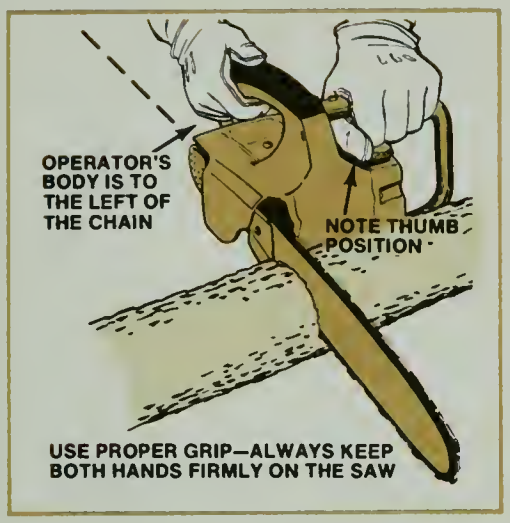
Any engine that has fired a few times on full choke will start at half choke. To restart a warm engine, crank it at half choke. A hot engine usually needs no choking at all.

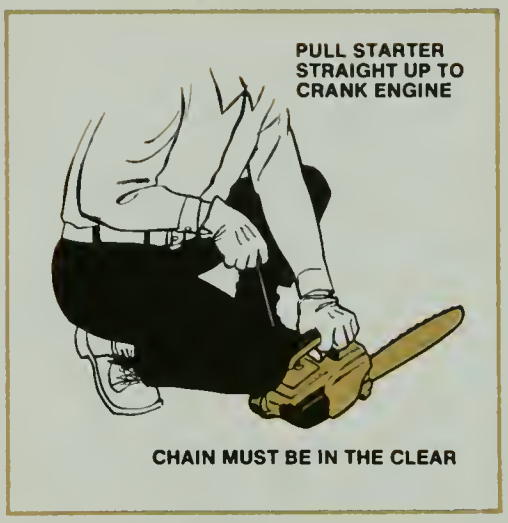
If you are taking your saw into the woods, bring along a scabbard for the cutting bar, fuel mixture and chain oil in safety containers, plastic or wooden wedges, a sharp hatchet or single-blade axe and touch-up tools for the cutting chain. If the woods are dry, also bring a shovel or a fire extinguisher.

Prepare the work area by clearing away any brush or debris that could interfere with you or the saw. If you are felling a tree, remember to have a clear path diagonally away from the direction of fall. This path should be free of branches or roots or anything that could trip or obstruct you as you walk away from the base of a falling tree.

Start the saw and open the throttle fully just before making the cut. Whenever possible, start the cut with the bumper of the saw against the work. This will counteract the tendency of the saw to pull away from you when you are cutting with the bottom of the bar.

➤ *Always take a firm stance so you will not lose your balance when the saw cuts through.*





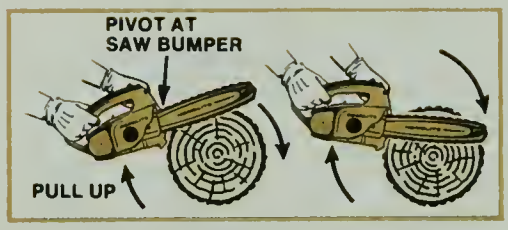
When you are cutting with the top of the bar, the saw has a tendency to push toward you. Always take a firm stance so that, when the saw cuts through and the working pressure is relieved, you won't lose your balance.

Take the wind into account and the natural lean of the trunk as well as any heavy branches when you decide where you want a tree to fall. Also, look for rotten spots and for dead branches that could drop on you if they are shaken loose.

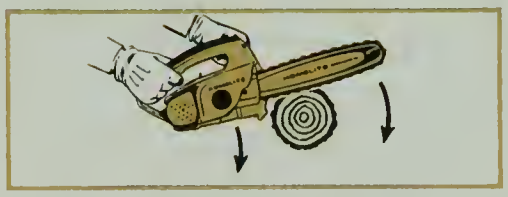
Once you have decided the direction of fall, cut a felling notch on that side of the trunk. The bottom of the notch is a horizontal cut about one third into the trunk. Complete the notch with a downward diagonal cut.

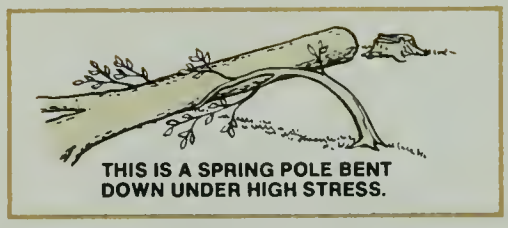
Next make a felling cut on the side of the trunk opposite the notch. This cut is also horizontal, but about two inches higher than the bottom of the notch. Cut toward the notch, but do not cut all the way through. Leave a strip of wood between the notch and the felling cut about two-inches wide all the way across the trunk. This uncut strip of wood acts as a hinge for the falling tree and tends to control the direction of fall.

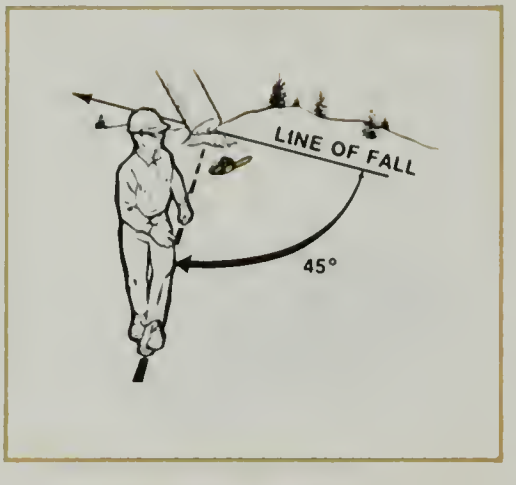
When you have completed the felling cut, drive a wedge—wood or plastic, never iron—into the felling cut and force the tree over. As the tree starts to fall, walk diagonally back and away from the trunk.



Whenever possible, start cut with the bumper of the saw next to the work. When cutting large logs, pull up on the handle and let the cutting bar pivot downward through the work. For small logs it is not necessary to pull up.







▲ *This is the basic kit of equipment you'll need for a day of cutting in the woods.*

You can also use a wedge in the felling cut if the tree looks as if it is going to rock backward and bind the saw, but be sure the saw never touches the wedge. If it does, it could kick back hard.

Cutting a felled tree or logs with a chain saw is quick work if you remember that wood is heavy and logs are very often under stress. If the tree you felled, for example, bent another smaller tree or sapling beneath it as it crashed to the ground, the bent tree is exerting a lot of pressure.

If you cut the felled tree, each of the two parts of the tree weigh less than the whole tree. What was heavy enough to bend down a smaller tree could easily spring back when some of the weight is removed. When this happens, the log could be flipped in almost any direction. So look before you saw, and be careful.

Generally, even logs that are just resting on the ground are under some stress, as are large branches. The general rule to follow is to make a cut on the side away from the direction of stress and then make the final cut on the opposite side. For example, to remove a heavy tree limb, cut first on the underside and complete the removal with a cut on the top.

See also: MAINTENANCE, CHAIN SAW; POWER TOOLS.

➤ *Cuffless trousers, trim fitting clothing and safety goggles are essential for working with a chain saw anywhere, as are skid-proof footwear. In addition, if you wear gloves make sure they have non-slip palms and fingers. If you are felling trees, wear a hard hat for protection from serious injury if large dead branches fall from a tree you are cutting. Hearing protection devices are necessary only if you work with a chain saw for extended periods.*